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AUTHOR Larsen, Bud: Swartz, Linda
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ABSTRACT

The curriculum materials in this manual are designed to support life science programs at levels seven and eight, and nine and ten, when appropriate. Field activities are focused upon and can be completed with the supervision of teachers, an older student, or an adult volunteer. Each activity contains background information, data pages, and/or discussion questions. The manual is divided into two sections: (1) investigations of the aquatic environment, and (2) the terrestrial environment. (Author/RE)

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ECOLOGY ENRICHMENT

GRADES 7-8

Developed by
Rocky River City Schools

Gordon E. Rodeen, Superintendent
Peter Metro, Project Director

INSTRUCTIONAL MATERIALS EXCHANGE

SE 029 541

Distributed by OHIO DEPARTMENT OF EDUCATION
Division of Planning and Evaluation

CREDITS

Authors

Bud Larsen
Science Subject Matter
Specialist and Science Teacher
Rocky River Junior High School

Linda Swartz
Life Science Teacher
Rocky River Junior High School

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FOREWORD

The Division of Planning and Evaluation of the Ohio Department of Education is pleased to announce the Instructional Materials Exchange program. This pilot venture is being conducted in cooperation with the following developer school districts:

Ashland County-West Holmes Joint Vocational School
Cincinnati Public Schools
Cleveland Public Schools
Columbus Public Schools
Parma City Schools
Rocky River City Schools
Struthers City Schools

The materials included within the series were developed under grants awarded to the above mentioned school districts by the Division of Planning and Evaluation during the past two years.

The Instructional Materials Exchange has been initiated so that more Ohio school districts can benefit from developmental project efforts by adopting practical educational products and ideas into their systems. If this pilot effort is successful, as evidenced by sufficient numbers of educators requesting materials, the dissemination effort will be expanded to include a greater variety of educational products.

The products included in this program were selected for use by Division staff members on the basis of effective field test results and the potential of the products to be used by a greater number of schools. Distribution is being made to schools without charge as long as a supply remains available.

To permit the maximum number of schools to participate, the volume of materials that may be obtained has been limited. Permission is granted by the Ohio Department of Education and the respective school districts, however, for local reproduction of the materials in any quantity desired. Reproduction beyond the intended scope of this program, such as for commercial distribution, is prohibited.

We welcome your comments regarding the materials provided, as well as your recommendations for future inclusions of products and ideas within the Instructional Materials Exchange program.

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ECOLOGY

USE OF MATERIALS

The curriculum materials in this manual are designed to support life science programs at levels seven and eight. When appropriate, they may also be used at levels nine and ten.

Although the activities are primarily field centered and focus on the ecology of the Rocky River-Lake Erie region, most can be used in any area where natural aquatic and terrestrial habitats are available. An outdoor education center, a park, a pond, a stream or a wooded area should be readily accessible for class use.

The manual contains a variety of environmental activities designed to get students out of the classroom and into the field. Various activities can be completed with the help of teachers, with a high school student or adult volunteer, or by the individual student.

Each activity contains background information, data pages, and/or discussion questions. All activities and worksheets may be duplicated as needed.

In the developer district, adult and high school volunteers have been trained to assist in the teaching process. This permits a teaching situation in which groups of five or less students are supervised and instructed by one volunteer. It is recommended that school districts planning to use any portion of this program should explore the potential for training and utilizing volunteer personnel.

AQUATIC

THE POND

FRESH WATER COMMUNITIES "PONDERING A POND"

Background:

A *community* is a group of plants and animals that live together and depend on each other.

Communities are made up of *producers, consumers,* and *decomposers.* Producers make their own food. Consumers get their food from other living organisms. Decomposers break down dead plants and animals into simpler substances that can be used again by producers in making food.

Organisms in a community are related to each other by what they eat. We call this relationship a *food chain.* Many food chains overlap each other forming a larger picture of how organisms are interrelated. We call this picture a *food web.*

Let us take a look at a pond to learn more about the organisms of this particular community. The community includes not only the water of the pond, but the air above the pond and the land around the pond.

Instructional Objectives:

1. Given a sketch of a pond each student will be able to observe and identify at least *fifteen* pond community organisms and show the area of the pond community in which they live.
2. Each student will be able to name at least four producers and three consumers that live in a pond community.
3. Each student will be able to correctly construct two different food chains using the plants and animals he has observed.
4. Each student will be able to correctly construct a food web using at least 10 of the organisms he has observed.

Materials:

1. Data Sheet 1 showing miniature sketch of pond area.
   Data Sheet 2 — "Questions to Ponder"
2. Pencil

Optional Equipment:
Binoculars and magnifying glasses

Procedure:

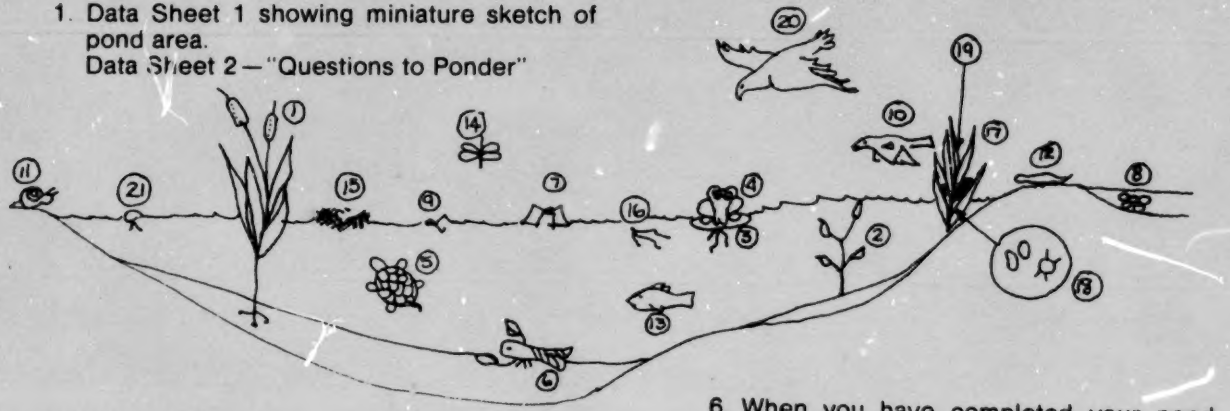
A. 1. Read pp. 4-12 on "Life in a Pond" in *Life — Its Forms and Changes.*

2. Get a pond data sheet from your instructor.

3. Your assignment is to work with a partner in observing life in a pond. You will probably find it best to stay in one spot for a few minutes to record your observations and then move on to another spot. Life can be observed in many places — under rocks, in the air, on plants, and in the water itself.

4. Use your data sheet to write down plants and animals as you see them. Also record the approximate area in which they are seen. Number the organisms and try to name them. If you don't know the names of some of the things you observe, identify them by general terms such as underwater plants, water bug, floating algae, blackbird with red on wings, etc. Continue your observations until you have at least 15 things on your list. At least five of these should be plants. You may also include evidence of animals such as foot prints, bird nest, animal hole, animal eggs, skin or shells of animals. See sample below:

5. On your data sheet you also have a pond sketch. Try to draw the living things you saw in the approximate area in which they were observed. Number each organism you draw to correspond to the list you made. Here is a sample pond sketch.



6. When you have completed your pond sketch, show it to your instructor and have it signed.

Go to Part B

Area of Pond (Check one or more)

Organism	Along Shoreline	Between shore & knee-deep water	Between knee-deep and waist high water	In the Air
1. Cattails	X	X		
2. Underwater plant			X	
3. Lilypad		X		
4. Frog	X	X		
5. Turtle	X			
6. Crayfish		X		
7. Water strider		X (on top of water)		
8. Turtle eggs	X			
9. Whirligig beetle	X			
10. Red-winged blackbird				X
11. Snail	X			
12. Salamander	X			
13. Fish (bluegill)			X	
14. Dragonfly				X
15. Bird's nest		X		
16. Algae-floating	X	X	X	
17. Water rushes	X			
18. Algae on leaves of plants				X (on plants)
19. Bird's nest				X (on plants)
20. Hawk				X
21. Duckweed	X	X		

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Pondering A Pond Data Sheet 1

Name _____

Date _____

Module _____

Where I saw organism (check one or more)

Organism	Along Shoreline	Between shore & knee-deep water	Between knee-deep and waist high water	In the Air

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Pond Sketch

Instructor's Signature

Name _____

Date _____

Module _____

B. Now that you have observed a pond community, see if you can answer these questions:

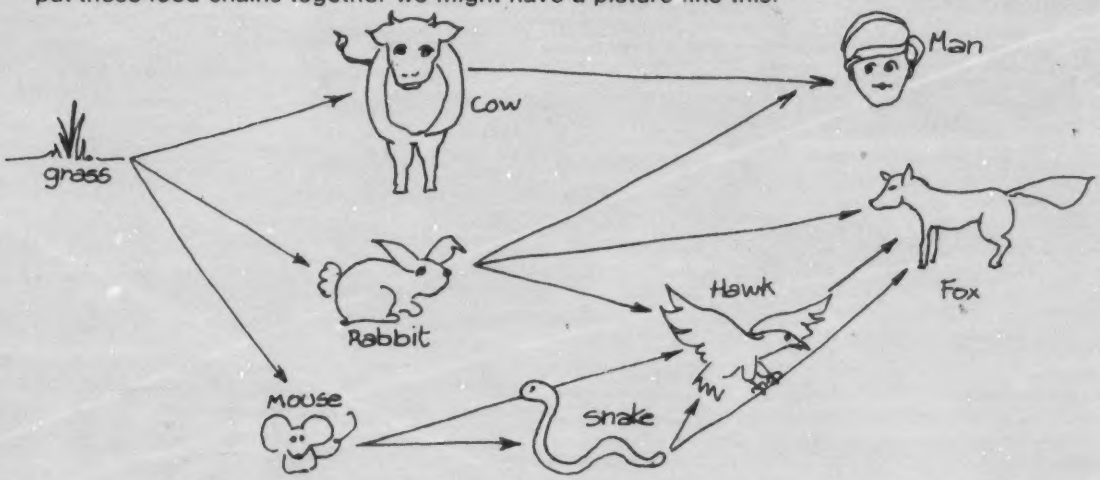
"QUESTIONS TO PONDER"

1. How many kinds of plants did you observe?
2. Of what importance are the plants to other organisms in the community?
3. How many kinds of animals did you observe?
4. Of what importance is each animal to other organisms in the community?
5. Name four or more different producers you saw in the pond community.
6. Name three or more different consumers you observed.
7. Did you see any of the animals eating?
8. Animals eat because they need energy. What do the small animals of the pond eat?
9. What do the larger pond animals eat?
10. Do plants eat?
11. Where do green plants get their energy?
12. Living things cannot live alone. They are related to each other by what they eat. We call this relationship a *food chain*. Small animals cannot usually eat bigger animals. What *do* they eat?
13. A food chain always starts with a green plant. Here is an example of a food chain:
    grass mouse snake hawk

    Use the pond organisms you observed to make two different food chains:

    A.

    B.
14. Why do plants and animals eat each other?
15. What is passed along in a food chain from one living thing to another?
16. What is a food chain?
17. Food chains are really part of a bigger picture. A cow eats grass, but so do rabbits and mice. Man might eat a cow or a rabbit, but a fox or hawk might also eat a rabbit, a mouse, or a snake. If we put these food chains together we might have a picture like this:



See if you can draw a food web using at least 10 of the organisms you observed. You may use words instead of drawings.

_____

Instructor's Signature

TO KEY OR NOT TO KEY

Background:

If you found a plant or animal that you had never seen before, how could you determine what it was? You could probably guess a tree, a grass, or bird, snake, or mammal. Or maybe you would have no idea at all.

Taxonomy is the science of naming or classification. Taxonomists have devised dichotomous (two-part) keys to help us identify plants and animals that we don't know.

Instructional Objectives:

At the end of this unit you should be able to use a dichotomous key to correctly identify 6 tree leaves and 8 insects.

Materials:

1. Dichotomous keys
2. Slides of 6 tree leaves and 8 insects
3. Data sheets

Procedure:

Place a pen, pencil, nickel, and a penny on the table. Let's pretend that you are totally unfamiliar with what they are. Here is a sample key:

1a) Cylindrical in shape.....2
1b) Not cylindrical, more round.....3
2a) Dispenses fluid which leaves a mark on paper.....pen
2b) Does not dispense fluid. Has a solid core which leaves a mark on paper.....pencil
3a) Copper colored, 19mm in diameter .....penny
3b) Silver colored, 21mm in diameter .....nickel

How to use the key: choose one of the objects you wish to identify. Look at choice 1a. If the description fits you are told to go to choice 2. If it does not fit, look at choice 1b, you are told to go to choice 3. At choice 2 you have 2 more descriptions, a and b. If you are at choice 2, the object is identified for you. If you went to choice 3 there are two descriptions for you. One of them identifies the object in question.

If you think you know how to use the key, take the slides of either insects or leaves and the corresponding keys and identify the pictures. Complete the data page by placing the name of each organism in the respective block.

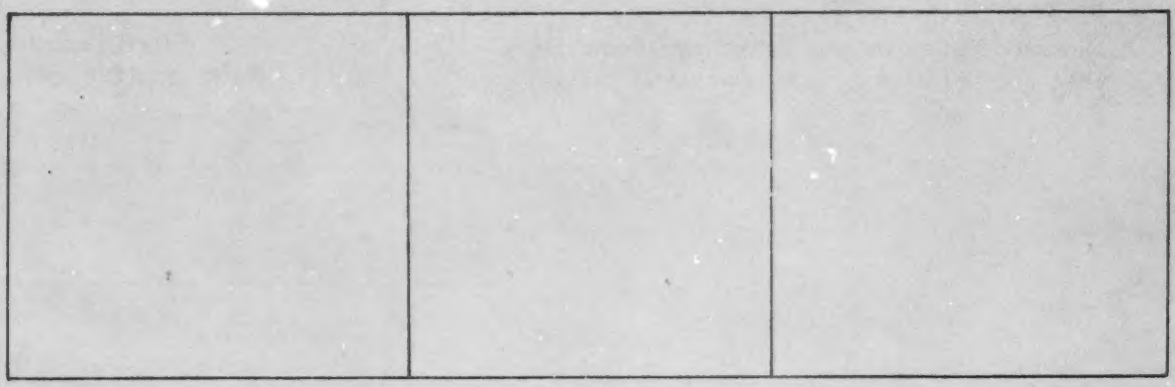
"To Key or Not To Key" Data Page – Leaf Keys

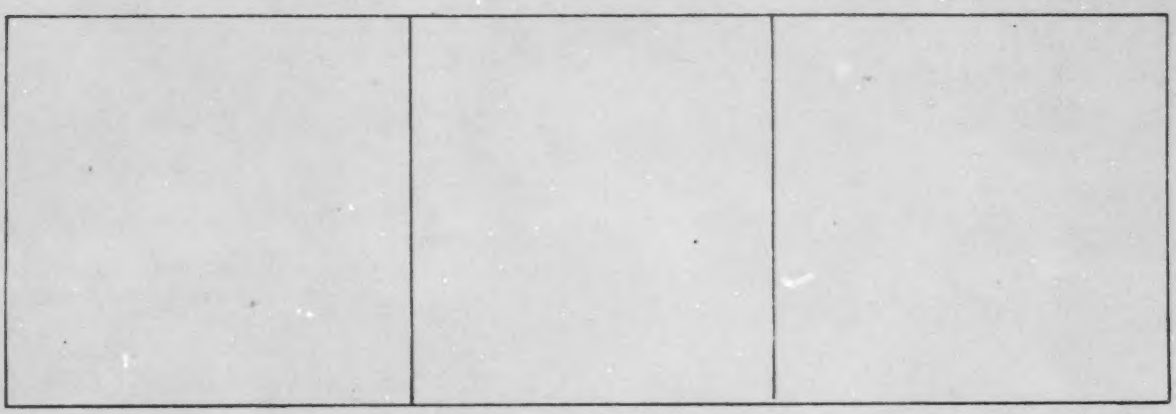
Name _____

Date _____

Module _____

1. Leaves needle like ..... Pine
1. Leaves not needle like 2
2. Leaves lobed 3
2. Leaves not lobed 4
3. Lobes deeply indented ..... Oak
3. Lobes not deeply indented ..... Maple
4. Margin of leaf smooth ..... Red Bud
4. Margin of leaf not smooth 5
5. Leaf more round than oval ..... Quaking Aspen
5. Leaf more oval than round ..... Elm





_____

Instructor's Signature

"To Key or Not To Key" Data Page — Insect Keys

Name _____

Date _____

Module _____

1. Wings transparent 2
1. Wings not transparent 3

2. Body with black and yellow stripes. Narrow wings . . . . . Hornet (Hymenoptera)
2. Body without black and yellow stripes. Wings as broad as the body . . . . . Cicada (Homoptera)

3. Wings covered with scales . . . . . Sulfur Butterfly (Lepidoptera)
3. Wings without scales 4

4. Body extremely long, 8-12 cm., front legs modified for grasping . . . . . Praying Mantis (Orthoptera)
4. Not as above 5

5. Body with black and yellow stripes . . . . . Locust Borer (Coleoptera)
5. Not as above 6

6. Head coming rather to a point. Body generally five-sided . . . . . Stink bug (Hemiptera)
6. Not as above 7

7. Legs modified for jumping. 2 abdominal appendages . . . . . Cricket (Orthoptera)
7. Legs modified for running. No abdominal appendages . . . . . Cockroach (Orthoptera)

_____

17 Instructor's Signature

FRESHWATER COMMUNITIES – "KEYED UP OVER A POND COMMUNITY"

Background:

You have learned that a pond community is made up of many plants and animals that depend on each other. When you observed these plants and animals you probably found there were some organisms you could not name. This activity will help you use your powers of observation to find the names of organisms you do not know.

A common way to identify the name of an organism is to leaf through a book until you find a picture of it or a picture very close to it. This works many times, but sometimes there isn't a picture that looks like your organism.

Another way to identify an unknown organism is to read descriptions until you find one that fits. This can be quite time consuming.

You can avoid some of these problems by using a Key. A Key forces you to observe important characteristics of an organism and systematically helps narrow down possible choices of what it might be. You also find yourself learning more about the organism (how it eats, how it moves, etc.) by using a key.

In this activity you will learn how to:

1. Use collection equipment
2. Identify pond community organisms
3. Properly label and record important information

Instructional Objectives: You will:

1. Use various pieces of equipment to collect one or more organisms from the pond community.
2. Sort the organisms and place each into a container for study and identification.
3. Put a label on each container telling where you found the organism (under rock, on land, on cattail, swimming in ankle-deep water, etc.)
4. Use a Key to identify the class of at least 5 animals from the pond community.
5. Use pictures or a Key to identify the common name of 3 animals from the pond community.
6. Use pictures and/or a Key to identify at least two plants from the pond community.

Materials:

Pond net
Dip nets
Plankton net
Kitchen strainers
Insect nets
Plastic pails
Plant hook (to cast for underwater plants)
Sorting trays (white bottom pans or white plastic dishpans)
Small mesh screening
Forceps
Eyedroppers
Killing jars (for insects)
Jars (widemouth) of various sizes
Plastic bags & twisties (for plant specimens)
Tape & marking pens for labeling
Old tennis shoes, boots or waders
Knapsacks
Hand lenses
Microscopes — compound & dissecting
Microscope slides

Identification Guide Books:

1. *Pond Life — Golden Nature Guide* — Reid & Zim
2. *A Field Guide to the Birds* — Roger T. Peterson
3. *Fishes — A Golden Nature Book* — Zim & Shoemaker
4. *Reptiles & Amphibians — Golden Nature Guide* — Zim & Smith
5. *Insects — Golden Nature Guide* — Zim & Cottam
6. *Spiders and Their Kin — A Golden Nature Guide* — Levi
7. *Field Book of Ponds and Streams* — Ann Morgan
8. *Keys to the Common Animals of the North Central States* — Eddy & Hodson

"Key For Identifying Common Animals"
Data sheets for identifying pond animals

Procedure:

A. *Collecting:*

You have learned that different plants and animals are found in different places in the community. Animals can be found under rocks at the bottom, swimming in the water, living at the surface of the water, on plants, or in the air. Plants also occupy different zones of the pond community. Some live underwater attached to the bottom, some will float on the surface of the water, and others, like cattails, will live mostly above the water. Keep these things in mind as you are looking for organisms to collect.

Also remember that living things depend on each other and their environment. Don't take more specimens than needed for study. When possible, the specimens you collect should be returned to the pond area after study and identification is completed.

The instructor will divide the group into three teams. Each team will be given a designated area for collecting. A list of equipment and directions for each team is as follows:

TEAM A—Shoreline Collectors—You will need: insect nets, pails, killing jars, collecting jars, plastic bags & twisties, knapsack, forceps, and sorting trays.

Collect plants and animals you find anywhere along the shoreline—under rocks, in grass or weeds near edge of pond, or buried in dirt, etc. Use insect nets to sweep grassy areas. Plants along the shoreline may be wrapped in plastic bags with a little water. Don't forget to look for snails, planaria, etc., under rocks or plants. Larger specimens may be transferred to a sorting tray.

TEAM B—Knee Deep Collectors—You will need boots or old tennis shoes, kitchen strainers, pails, a dip net, plastic bags, eyedroppers, and collecting jars. Look on the surface of the water and also on the mud bottom of the pond. Sticks, strainers, and even feet may be useful in stirring up life from the bottom of the pond. Floating plants such as algae or duckweed may be placed in a baggie containing a little pond water and fastened shut with a twistie. Transfer the collected specimens into collecting trays or jars, depending on their size.

TEAM C—Deep Water Collectors—You will need pails, plankton net, plant hook, pond net, collecting jars, plastic bags and twisties. The pond hook may be cast from shallow water to dredge up submerged plants from as deep water as possible. If you drag the hook along the bottom of the pond you will probably catch several animals, too. The plankton net can be used to collect samples of pond water that can be taken back to the classroom for studying microorganisms later.

B. *Sorting:*

After you have collected your specimens, your next task is one of sorting and labeling. Place each different kind of organism in a jar or bag and use tape and a marking pen to record where you found the organism (under a rock, on shore, swimming in ankle-deep water, etc.) Larger organisms like frogs and fish should be kept in a pail or pan with enough water to keep them alive. You may need to cover the pan with screening so your animals will not get away.

C. *Identification*

Once the sorting is completed the various containers can be taken to a central area where they can be numbered to make studying them easier.

1. Obtain a data sheet and "Key for Identifying Common Animals".

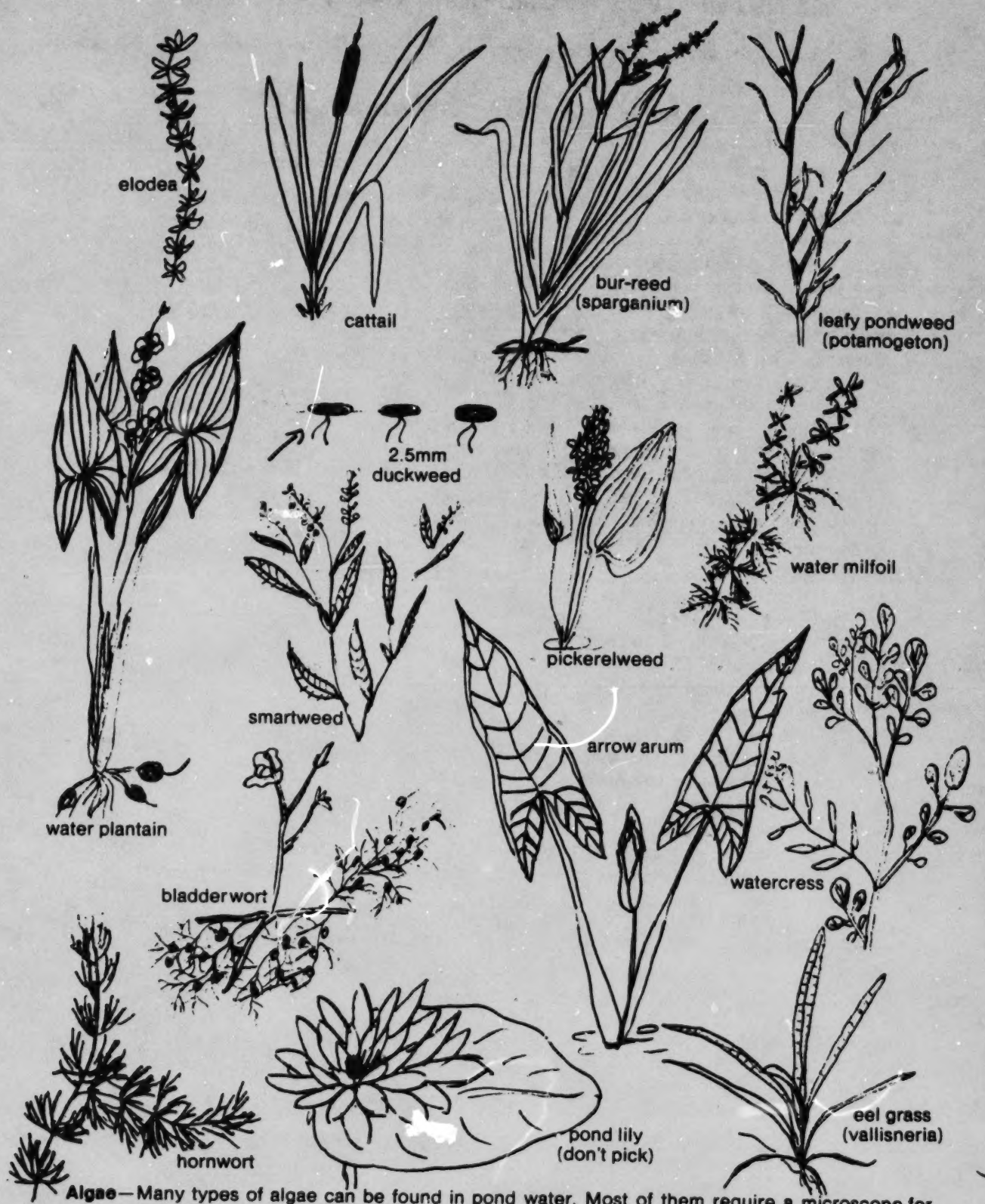
"KEYED UP OVER A POND COMMUNITY" – continued

Following is a Key to identify the Phylum or class of common animals you may see. Use your powers of observation to help you use this Key.

KEY FOR IDENTIFYING COMMON ANIMALS

1a. Has legs . . .2
1b. Doesn't have legs . . . 10
2a. Has fur or hair . . . *Mammal*
2b. Doesn't have fur or hair . . . 3
3a. Has feathers and wings . . . *Bird*
3b. Doesn't have feathers or wings . . . 4
4a. Has smooth moist skin and 4 legs . . . *Amphibian*
4b. Does not fit description in 4a . . . 5
5a. Has 4 legs, shell, and scales . . . *Reptile* (turtle)
5b. Has no shell, but does have hard exoskeleton and segmented body . . . *Phylum Anthropod* . . . 6
6a. Has 6 legs and 1 pair of antennae . . . *Insect*
6b. Does not fit description in 6a . . . 7
7a. Has 1 pair of antennae, flattened body, 1 pair of legs on each body segment . . . *Centipede*
7b. Does not fit description in 7a . . . 8
8a. Has 1 pair of antennae, cylindrical body, 2 pairs of legs on each body segment . . . *Millipede*
8b. Doesn't fit description in 8a . . . 9
9a. Has 2 pair of antennae, 1 pair of legs for each body segment (most found in water) . . . *Crustacean*
9b. No antennae, 8 legs . . . *Arachnid* (spiders, mites, ticks, daddy long legs)
10a. Has scales . . . 11
10b. Has no scales . . . 12
11a. Has fins and gills . . . *Fish*
11b. Has no fins or gills . . . *Reptile* (snake)
12a. Body wormlike . . . 13
12b. Body not wormlike . . . 18
13a. Found on land . . . 14
13b. Found in water . . . 15
14a. Body segmented, no eye stalks . . . *Phylum Annelida* (earthworm)
14b. Body not segmented, has eye stalks . . . *Phylum Mollusca* (slug)
15a. Body somewhat flattened . . . 16
15b. Body more roundish . . . 17
16a. Body ribbon-like, not segmented, less than ¾" in length . . . *Phylum Platyhelminthes* (flatworms)
16b. Body segmented, sucking mouth, usually longer than ¾" . . . *Phylum Annelida* (leech)
17a. Segmented . . . *Insect* (larvae)
17b. Not segmented . . . *Phylum Nematoda* (roundworms)
18a. Has a shell . . . *Phylum Mollusca*
18b. Has no shell, is fishlike but has no scales . . . *Amphibian* (tadpole)

Some Common Aquatic Plants



Algae—Many types of algae can be found in pond water. Most of them require a microscope for identification—see algae key for more information.

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"KEYED UP OVER A POND COMMUNITY"

Module_____

Pond Organism Identification Sheet

#2. Animal Container No.	Class	#4. Common Name

#3. Instructor's Signature_____ #4. Instructor's Signature_____

#5. Plant Container	Common Name

#5. Instructor's Signature_____

"DON'T PREY FOR ME" – A PREDATOR-PREY STUDY

Background:

Animals have to have food to stay alive. They obtain food by eating other living things. An animal that catches, kills, and eats other animals is a *Predator*. The animal is caught and eaten if the *Prey*.

Predators control the size of populations. If there were no predators, certain animals would become very numerous. If animals that eat the same thing become too numerous, there is not enough food to go around and the animals become sick and die. Predators help to eliminate weaker members of the prey, thus leading to healthy survivors.

Instructional Objectives:

1. Each team of students will catch at least 1 hydra and 1 daphnia.
2. Each student will observe the hydra and daphnia and correctly determine which is the predator and which is the prey.
3. Each student will be able to determine the function of a predator in a community.

Activity:

In this activity you will work in teams to study a predator-prey relationship.

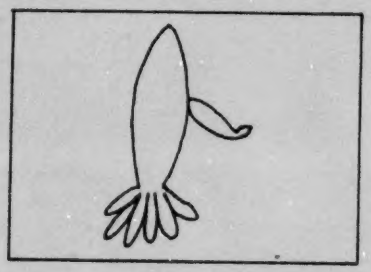
Materials:

Each team will need:

1. One (1) microscope
2. One (1) jar
3. One (1) small glass vial
4. One (1) eyedropper
5. One (1) microscope slide
6. One (1) pond
7. One (1) hydra
8. One (1) daphnia
9. "Don't Prey for Me" data sheets

Procedure:

1. With your teammates catch a hydra. A hydra spends its life attached to stems of underwater plants or under lily pads in a pond. It is about 8 mm long and almost clear or slightly greenish. You have to look very hard to find it. If you find several hydra, give your extras to other teams.



2. When you locate a hydra, place it in your collecting vial with a little pond water.
3. Don't shake the vial or disturb the hydra. Observe it for 3 minutes. On your data sheet, describe what you see the hydra doing?
4. You should be able to see some small animals swimming in the water. Use a jar to scoop up some pond water containing these animals.
5. Use an eyedropper to catch one of the animals in your jar. Place it on a clean microscope slide, and look at it under a microscope to see if you have a *DAPHNIA*. A Daphnia looks like this:

6. When you find a daphnia, catch it and add it to your vial containing the hydra.
7. Don't disturb the hydra, but observe the vial for 5 or more minutes. On your data sheet, describe what you see happen between the hydra and the daphnia.
8. Answer the rest of the questions on your data sheet.

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Data Sheet—"Don't Prey For Me"

Name_____

Date_____

Module_____

3. _____

_____

7. _____

_____

9. An animal that catches, kills, and eats other animals is a *predator*. The animal that is caught and *eaten* is the *prey*. Which is the predator, the hydra, or the daphnia?_____

10. Which one is the prey?_____

11. You have probably seen hawks circling the sky at some time. What are hawks looking for?_____

_____

12. The hawk may make a sudden dive to catch a mouse or a similar small animal. Which is the predator, the hawk or the mouse?_____

13. Which is the prey?_____

14. Give another example of a predator-prey relationship._____

_____

15. What would happen if there were no hydra to eat daphnia?_____

_____

16. What would happen if there were no hawks to eat mice?_____

_____

17. What is the function of a predator in a community?_____

_____

18. When your activity is complete, have it checked by your instructor.

_____

Instructor's Signature

"DOES MY ADAPTATION MAKE ME ADEPT?"

Background:

Birds have light bones, strong muscles and feathers. These structures all help the bird to fly. We say the bird has special adaptations. The giraffe is adapted to feed from tall trees by having a long neck. The tiger is camouflaged by having stripes. The ostrich has long legs which make it especially adapted for running. The camel has a third eyelid to protect the eyes against blowing sand. The chameleon can turn its eyes independently. The praying mantis has its front legs adapted for holding food. It's hard to say just how these adaptations came to be. There are a few theories which try to explain how; nevertheless, they happened.

Organisms which live in a pond also have special adaptations. These adaptations help them to survive. In this activity you are going to study some of these organisms and their adaptations.

Instructional Objectives:

At the end of this unit you should be able to explain how the following organisms are adapted for 1) movement, 2) seeing, 3) eating, 4) escaping being seen (camouflage), 5) holding food:

1. The frog
2. The predaceous diving beetle
3. The whirligig beetle
4. Water boatman
5. Back swimmer
6. Giant waterbug

Materials:

1. Dip nets
2. Collecting bottles
3. Dissecting microscope
4. Key to order of more common adult insects (in manual)
5. Data sheet

Procedure:

Go to a pond and collect and/or observe a: 1) frog, 2) predaceous diving beetle, 3) whirligig beetle, 4) water boatman, 5) back swimmer, 6) giant water bug. At the pond or back at the lab examine the specimens for special adaptations for life in a pond. (See data page.) You may also want to refer to a text for more information on these particular animals. For some of the animals you may want to observe them in their natural environment.

The frog: Notice its mouth. Where are the teeth? Where is the tongue attached? What are the front legs for? Are they long or short? How many eyelids does it have? Why is one eyelid transparent? What color is it on the belly? On the back? Why are the hind legs long? Why are the hind feet webbed?

The insects: Notice their front legs. Are they adapted for any special task? Notice the hind legs on all the insects. Are any shaped like oars? Which insect has one leg longer than the other? How does it swim? Notice the eyes of all the insects. Does one insect have two sets of eyes? Where does this insect live in the water, at the surface or under-neath? How is this eye arrangement adaptive? What kind of mouth parts do the insects have? What is their function? What kind of coloration do the insects have? Is the ventral surface (underside) lighter than the dorsal surface (backside)? Does one insect have a coloration that is opposite from the others? How does this insect swim?

Complete your data page.

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Data Sheet – "Does My Adaptation Make Me Adept?"

Name_____

Date_____

Module_____

ADAPTIVE STRUCTURE	ORGANISM					
	Frog	Predaceous Diving Beetle	Whirligig Beetle	Water Boatman	Back Swimmer	Giant Water bug
Front legs and their function						
Hind legs and their function						
Eyes and their function						
Coloration and its function						
Mouth parts and their function						

Rocky River City Schools
Project ENRICH-Title III

_____
Instructor's Signature

"DON'T HOCK MY HACH KIT"

Background:

Just as we need food and oxygen to live, plants also must have these basic raw materials. In a pond community the water supplies the oxygen and food to most of the inhabitants. Also, organic substances in a pond will affect the life of the pond community. The purpose of this investigation is to enable you to perform water quality tests using a Hack Kit. You will test for substances such as nitrates and nitrites, acidity, and dissolved oxygen (DO). Acidity or pH is a measure of free hydrogen ions. If the pH is too high or too low life may not survive. You will also record the temperature of the water.

There are certain levels of those substances which are considered safe.* They are:

1. Nitrates—less than 10 parts per million
2. Nitrites—less than 10 parts per million
3. Dissolved Oxygen—not less than 5.0 parts per million
4. Acidity between 8.5-6.5

Instructional Objectives:

With the aid of a Hach Kit you should be able to determine the amounts of nitrites, nitrates, dissolved oxygen, and pH of a pond. With the aid of a thermometer you should be able to determine the temperature of the water.

Materials:

1. Collecting bottles
2. Waders or boots
3. Thermometer
4. Hack Kit
5. Data sheet

Procedure:

1. Randomly choose sites at the edge of the pond where the water is about 30 cm deep and where the water is about 60 cm deep.
2. At each site take water samples from the surface and, if possible, at a point halfway between the top and the bottom, and at the bottom.
3. Record the temperature of each sample.
4. Place the samples in suitable jars that are properly labeled and take the jars to the lab for testing. *Do the DO (dissolved oxygen) test at the pond site.*
5. In the lab use the Hach Kit and follow the procedure for testing for each substance.
6. Determine average volumes for samples taken at the 30 cm deep and 60 cm deep sites.
7. Fill in the data page.

**Water Quality Monitoring Manual*, Conservation and Environmental Studies Center, Whitesbog, N.J.

Water Pollution Control Board Resolution 3/14/72

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Data Page—"Don't Hock My Hach Kit"

Name_____

Date_____

Module_____

Site	Nitrate	Nitrite	DO	pH	Temp.
Edge					
30 cm Deep					
Top					
Middle					
Bottom					
Average					
60 cm Deep					
Top					
Middle					
Bottom					
Average					

SAFE LEVELS <10ppm <10ppm >5.0ppm >8.5-6.5

Complete the following chart using a + if the substance falls within the safe level and a − if it does not.

Site	Nitrate	Nitrite	DO	pH	Temp.
Edge					
Avg. 30 cm					
Avg. 60 cm					

_____

Instructor's Signature

THE DIVERSITY OF A POND

Background:

The diversity simply means the numbers of different types of organisms. The more different organisms there are the higher the diversity index and the more diverse the pond. Generally, very young and/or very old or polluted ponds will have low diversity indexes.

Instructional Objectives:

At the end of this activity you will be able to successfully determine the diversity index of macroinvertebrates of a pond.

Materials:

1. Dip nets
2. Collecting jars
3. White bottomed pan
4. *Taxonomic Keys to the Common Animals of the North Central States*—Eddy & Hodson
5. A Key to Insects: Golden Book and the Key to Orders of More Common Adult Insects
6. Data Page

Procedure:

1. Choose several sites randomly spaced within the pond. At each site take three samples so that the area is well covered.
2. Remove organisms from the nets and place them in labeled containers.
3. In the lab, place the specimens in a white bottomed pan. Separate them as to kinds and count each kind. (This will determine each species' population.)
4. Assign a letter to each group of specimens so each group has one identifying letter. Give specimens in each group consecutive numbers. For example, if there are 37 worm-like specimens, with black heads, these might be in Group A and have numbers 1-37. Fourteen snails of one type might be in Group B and have numbers 38-51, and so on.
5. Randomly select (by putting numbers in a hat and pulling them out, for example) numbers that correspond to the number of specimens.
6. To determine the number of "runs" (the numbers of continuous series of similar organisms): if the numbered specimen is in the same group as the one immediately preceding, it is part of the same run: if not, a new run is started. For example, take the following list: suppose that the first chosen number is 10. Number 10 organism is from Group A (remember worm with black head?) This will begin run #1. Organism #3, chosen next is of the same Group A and is therefore, also included in run #1. However, the next organism #40 is of Group B. Hence, a new run, #2 has begun. The remainder of the runs are formed in a similar way.

Organism Number	Group	Run
10	A	1
3	A	
40	B	2
52	C	3
6	A	4
4	A	
25	A	
39	B	5
45	B	
41	B	

There are a total of 5 runs in the 10 specimens listed. Diversity index is calculated as number of runs divided by number of specimens.

$$DI = \frac{\text{number of runs}}{\text{number of specimens}} = \frac{5}{10} = .2$$

7. From your sampling of pond water determine the diversity index of the pond you are studying.
8. Fill in the data page.

References:

A Curriculum Activities Guide to Water Pollution & Environmental Studies, Vol. 1, Institute for Environmental Education, Cleveland Heights, Ohio

Diversity of a Pond Data Page

Name_____

Date_____

Module_____

Organism Number	Group	Run

$$DI = \frac{\text{number of runs}}{\text{number of specimens}} =$$

_____

Instructor's Signature

THE CULTURED PARAMECIUM

Background:

Toward the beginning of the food chain of a pond there are single celled animals. The purpose of this activity is to collect some pond water, culture one type of single-cell animal, the paramecium, and then study the behavior and anatomy of the paramecium.

Instructional Objectives:

At the end of this activity you should be able to:

1. Successfully culture a population of paramecia
2. Use a microscope and observe a living paramecium, how it moves and how it reacts to stimuli
3. Use a microscope to observe a prepared slide of paramecia and identify:
   a. cilia
   b. oral groove
   c. macronucleus
   d. micronucleus
   e. food vacuole
   f. contractile vacuole

Materials:

1. Collecting bottle
2. Microscope
3. Text—*Life, Its Forms and Changes*, or other reference.
4. Data sheets

Procedure:

1. Collect a jar of pond water containing large quantities of dead and living vegetation. Allow it to stand in the laboratory for two or three days before searching for a specific micro-organism; paramecium which will be found in the surface scum or directly beneath it.
2. Use the microscope to study the living paramecium and then complete Part One of the data page.
3. Use the microscope to study prepared slides of paramecia and complete Part Two of the data page.

The Cultured Paramecium Data Page

Name_____

Date_____

Module_____

Part One

1. When you find a specimen that is fairly quiet, observe how it swims. What structure does the paramecium use for moving through the water?_____

2. The paramecium is sometimes called the "slipper animal" because of its shape. Which end of the slipper, the "heel" or the "toe", usually goes first as the animals move through the water?

_____

3. Which way does a typical paramecium rotate when it moves forward?_____

_____When it moves backward, which way does it rotate?_____

_____

4. Do paramecia move toward or away from the pull of gravity?_____

5. Paramecium undergo two types of reproduction, fission and conjugation. Use your textbook and identify which one is sexual and which one is asexual.

Fission is_____

Conjugation is_____

Do you observe either type of reproduction in your slide? Which one(s)?

_____

6. Describe the method of the paramecium in moving around objects. Do humans often employ the same method of response when facing a difficult situation?

_____

_____

_____

Instructor's Signature

The Cultured Paramecium Data Page

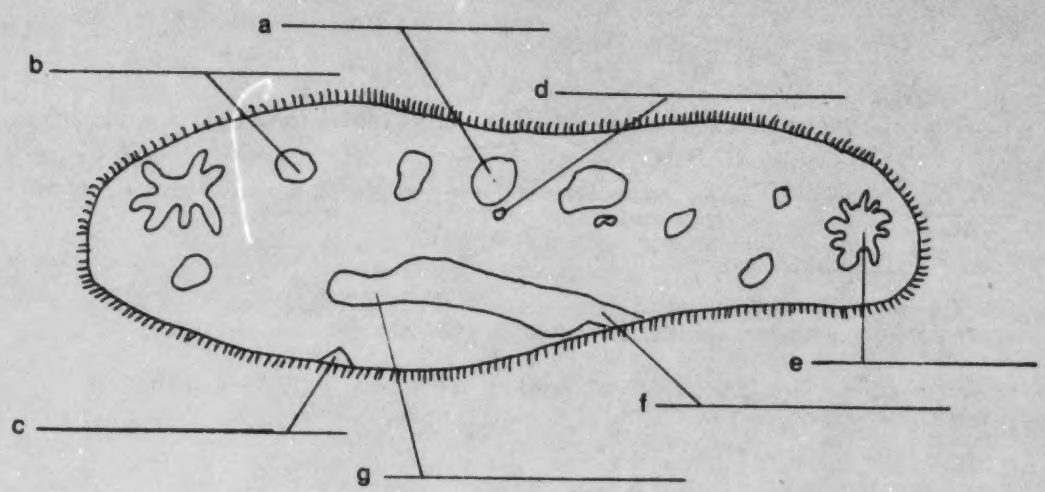
Name _____

Date _____

Module _____

Part Two

1. After you have completed your microscopic studies of both living and stained paramecia, label on the diagram below all the parts you were able to identify.



2. Where does food enter the paramecium's body? _____

3. Where is food digested? _____

4. Where do solid wastes leave the body? _____

5. What structures are used for the elimination of excess water? _____

_____

6. What structure controls reproduction and all the life processes of the paramecium? _____

_____

7. How many organelles did you identify? _____

_____

Instructor's Signature

"GOING ON AN ALGAE HUNT"

Background:

Algae are simple plants that have no true roots, stems, or leaves. Algae are of great interest and importance for several reasons; 1) they are the first link in most aquatic food chains; 2) they cause troublesome contamination of water supplies; 3) and they are used in foods such as flour, or as preservatives in foods such as ice cream.

Algae grow in almost any body of water or moist spot. Many kinds are microscopic, but some grow in large numbers forming what we frequently call "pond scum", "water blooms", "moss", or "seaweed".

Instructional Objectives:

In this activity you will:

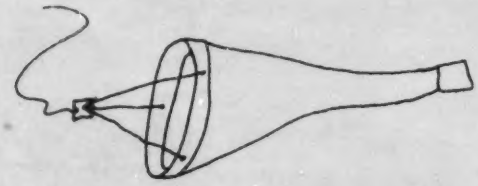
1. Collect algae.
2. Identify algae collected in at least two different places.
3. Identify three different kinds of algae.

Materials:

1. jars
2. algae
3. plankton net
4. masking tape
5. microscopes
6. cover slips & slides
7. forceps
8. eye droppers
9. "Descriptions and Pictures of Common Freshwater Algae"
10. Data sheet

Procedure:

1. Use a jar to collect some algae and enough water to cover the algae. You may find algae almost any place you find water. Look in ponds, rivers, lakes, mudpuddles (that have been standing for awhile), bird baths, shower stalls, aquariums, ditches, or even moist soil. Algae may be collected from an area of open water by using a *plankton net*. If you use a plankton net, check with your instructor first for proper way to use this piece of equipment.



2. Put a piece of masking tape on your jar with your name, date, and where you found the algae (on rocks in river, on bottom of boat, etc.)
3. Bring your algae to class.
4. Use forceps or eyedropper to place a very small piece of algae and a few drops of water on a clean slide.
5. Cover the algae with a cover slip and look at it under the microscope.
6. Use "Descriptions and Pictures of Common Freshwater Algae" to try to identify your sample. If none of the descriptions or pictures fit your sample, ask your instructor for further resources for identification.
7. Sketch and name your algae on the data sheet. Have your instructor check your identification.
8. Identify two more algae. You may have more than one kind in your sample. Your classmates have collected algae from various places. Identify at least one algae collected by a classmate. This sample should be from an environment different from your sample.
9. On your data sheet, sketch and name all the kinds of algae you identify. Have your instructor check your data sheet.

"DESCRIPTIONS AND PICTURES OF COMMON FRESHWATER ALGAE"

I. Algae found in temporary bodies of water (bird baths, aquarium, mud puddle).

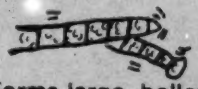
A. **Haematococcus**

Reddish to rust-colored scum found at bottom of shallow pools (bird baths, swimming pool, shower floor).

red ----→

B. **Oscillatoria**

Filamentous (stringy), blue-green to black in color, slimy to touch, often found on mud in a puddle, on wet soil, or on dripping rocks. Its filaments waver or oscillate so that a mass of it may creep up the sides of a dish.

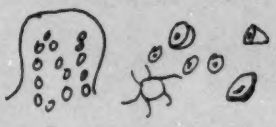


C. **Volvox**

Found in standing water such as a mud puddle. Forms large, hollow, sphere-shaped colonies. Daughter colonies form within parent. Under a microscope it looks like a green golf ball rolling through the water. Moves by whiplike tails (flagella) and contains chlorophyll.

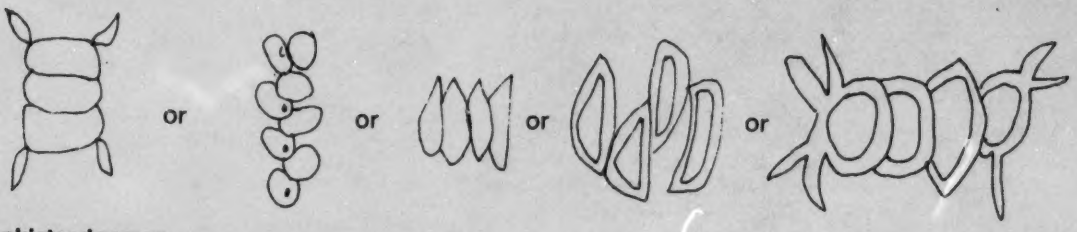
D. **Chlorella**

Found in aquariums, bottles, etc. Forms a green film against a glass wall. Made up of small cells that occur singly or in masses. May be found in the bodies of protozoa, especially ciliates.



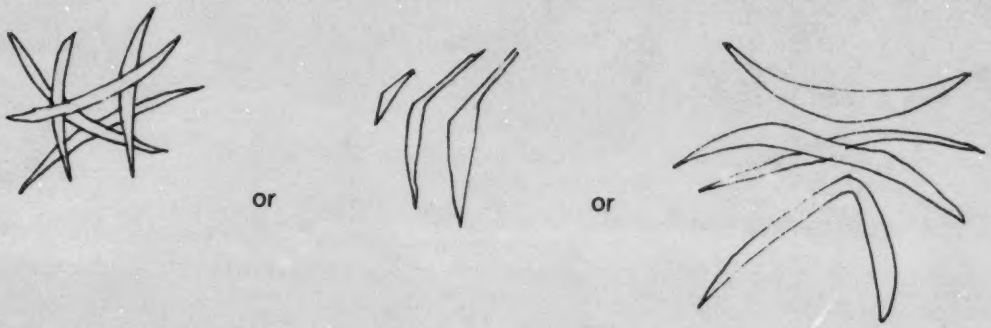
E. **Scendesmus**

Bright green. Found often in aquariums. Causes water to be uniformly green. Usually appear as single cells. Oval or crescent-shaped.



F. **Ankistrodesmus**

Often found in aquariums or artificial pools. Occurs in solitary or loosely clustered needles.



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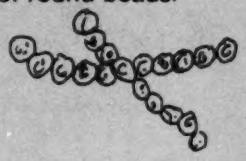
G. **Nostoc**

Found on wet soil or in slippery masses in ponds, swampy places, or pools. Looks like muddy masses of jelly. Under the microscope it looks like necklaces made of round beads.



H. **Coleochaete***

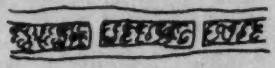
See description and picture under II., B.1.

II. Algae found in permanent body of water (lake, pond, stream).

A. Filamentous algae (found in stringy masses)

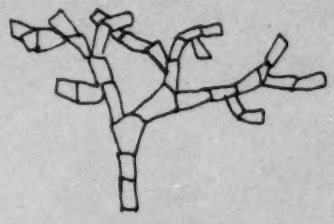
1. **Spirogyra**—"Pond Scum"

Forms long, bright green strings in water. Its floating masses sometimes cover the ponds. Very slippery to touch. Ends curl when held. Under microscope it looks like beads coiled into a spring within each cell of the filament.



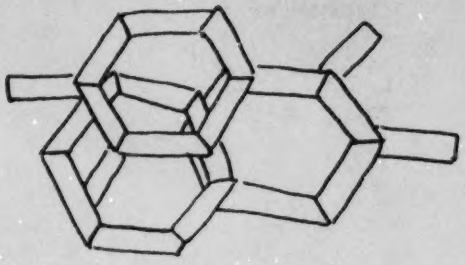
2. **Cladophora**

Found free-floating or attached to rocks or piers. Common in ponds, lakes, and streams. Often found in flowing water. Filaments are coarse and branched (not slippery). Under a microscope the branching looks almost like a glove or small tree branches.



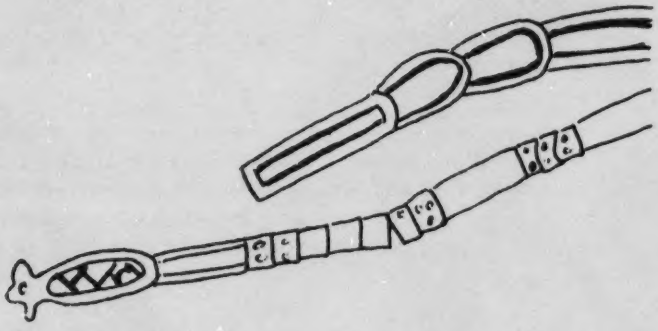
3. **Hydrodictyon**—"Water Net"

Free-floating. Bright green. Found in masses forming nets that float in sunny, still ponds, lakes, and irrigation ditches. Under a microscope you can see that the cells join together to make hexagons (6 sides). These nets are very visible to the unaided eye and can be more than two feet in length.



4. **Oedogonium**

Filamentous; usually found attached to weeds, rushes, or old cattail stalks. May become free-floating and form cottony masses near the surface of the water. If the water then dries by evaporation, they may form what is known as "algal paper".

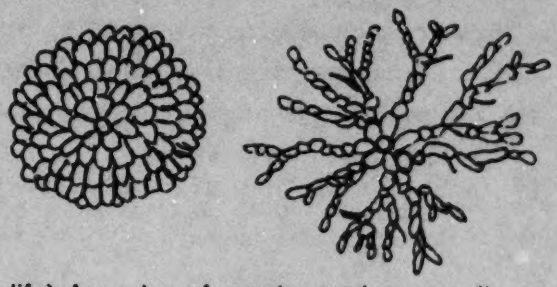


B. Non-filamentous algae (found in blobs, spheres, in colonies, or in solitary cells).

1. **Coleochaete**

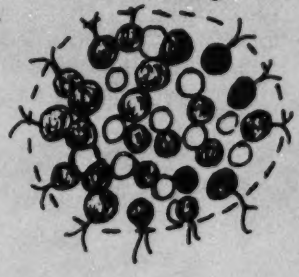
Colonial. Its flat, green discs may be attached to water lily leaves, submerged stems of cattails, or submerged glass or crockery.

*Also may be found on the sides of aquariums.



2. **Eudorina**

Found in plankton (floating microscopic life). A number of round or oval green cells appear to be evenly spaced in a mass of jelly-like substance.



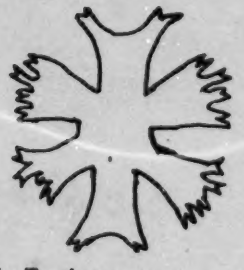
3. **Desmids**

Desmids are usually bright green cells, often made up of two semicells connected by a small clear area. They are commonly found in plankton (floating microscopic life) and form beautiful shapes (crescents, crosses, boats, etc.) Pictured below are some of the more common desmids you might find.

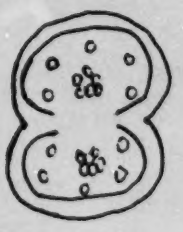
Closterium

Tetmemorous

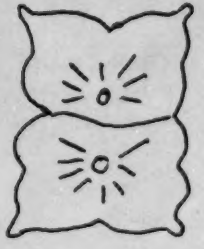
Micrasterias



Cosmarium

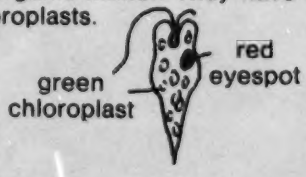


Euastram



4. **Euglena**

Euglena are sometimes classified as one-celled animals (protozoa) because they are able to move under their own power. They are like plants, though, because they manufacture their own food. Euglena are common in ponds that contain lots of organic matter. They have a whip-like tail, a red eye spot, and many green cells called chloroplasts.



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5. **Dinoflagellates**
Dinoflagellates are found in the plankton (floating microscopic life) of open waters. Many of them have hard armored plates. Pictured below are two dinoflagellates common to ponds and lakes.

Peridinium
(looks like a rolling walnut)

Ceratium
(looks somewhat like a chicken claw)

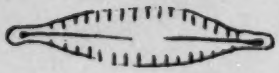
6. **Diatoms**
Diatoms are microscopic, golden colored algae that have intricate lines and designs on their cell walls. The cell walls are made of silica and are made up of two halves that overlap like a pill box.

Some diatoms are found in plankton, but more often they are found clinging to weeds, leaves, and submerged objects in a still pond. Below are pictured some of the diatoms you might find:

Tabellaria

Meridion

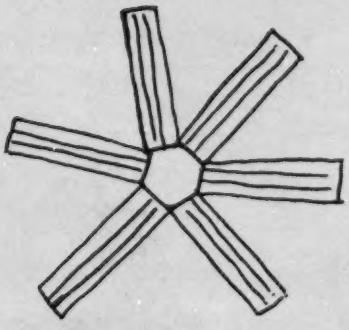
Navicula



Cymbella

Synedra

Asterella



Stephanodiscus

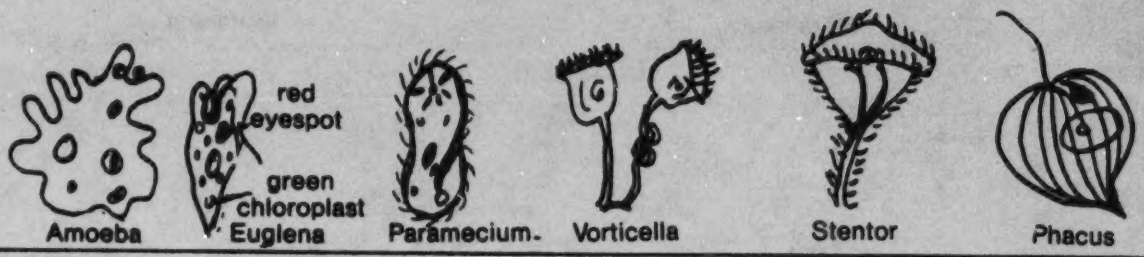
Cymatopleura

RESOURCE BOOKS FOR DESCRIPTIONS:

1. Prescott, G. W., *How to Know the Freshwater Algae,* Alsace Books & Films, Alton, Ill., 1970.
2. Laun, H. Charles, *Natural History Guide,* Wm. C. Brown Co., Dubuque, Iowa, 1964.

COMMON ANIMAL LIFE FOUND IN FRESHWATER COMMUNITIES

Protozoa (microscopic) one-celled animals



Amoeba · Euglena · Paramecium · Vorticella · Stentor · Phacus

Rotifers

Asplanchia · Monostyla · Philodina · Polyartha · Floscularia · Stephanoceras

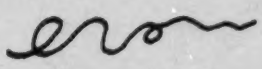
Mollusks

Little pond snail · River snail · Orb snail · Freshwater clam · Land snail · Slug

Coelenterates

Hydra

Roundworms and Flatworms

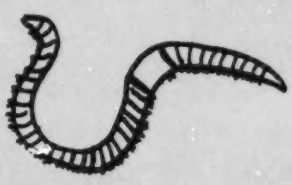


Horsehair snake (a roundworm)

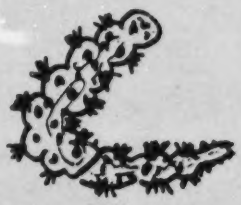
Planaria (a flatworm)

Annelids

Leeches



Earthworm

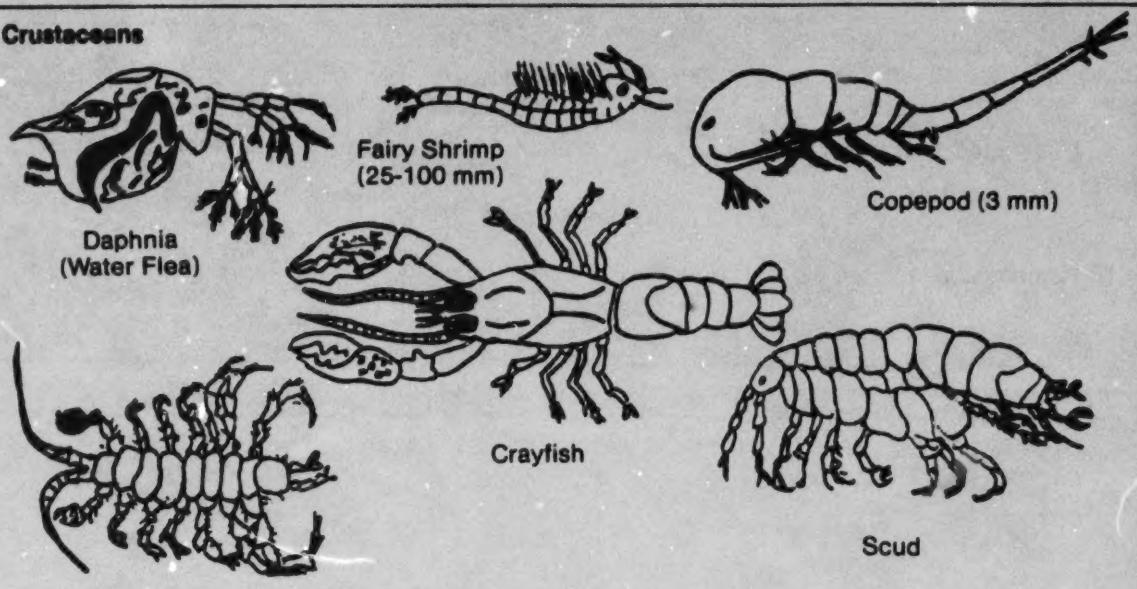


Aeolosomaworm (13mm)

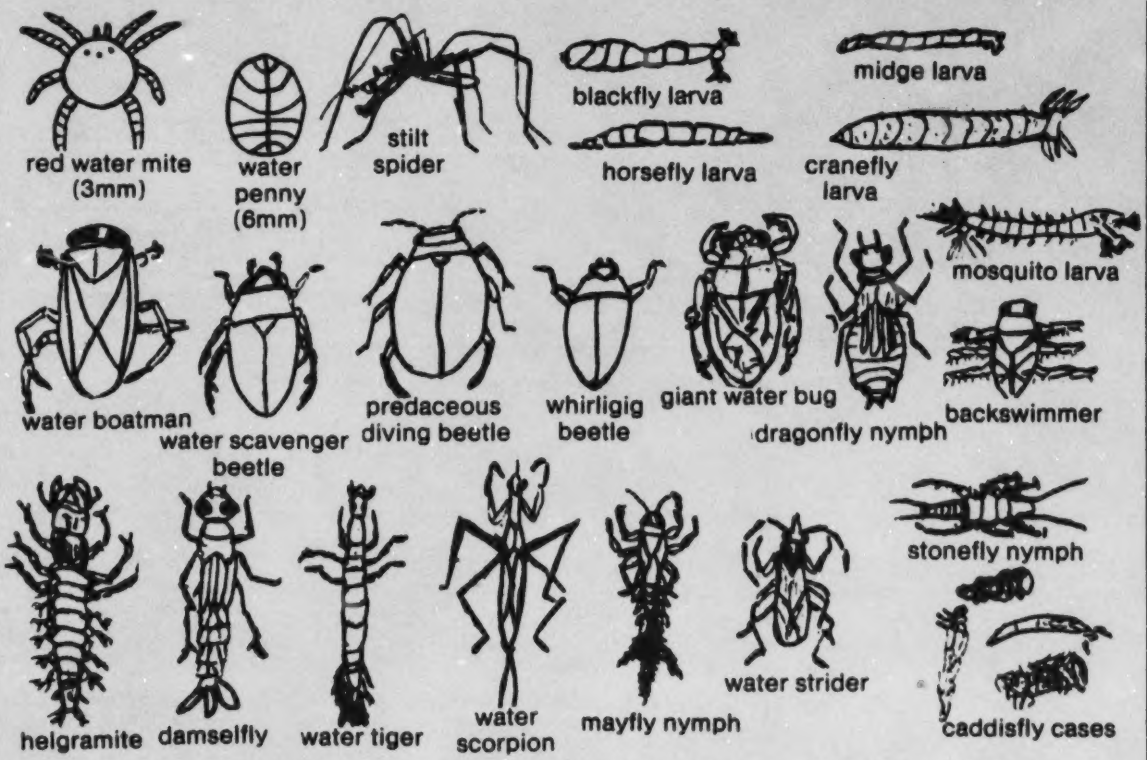
COMMON ANIMAL LIFE IN FRESHWATER COMMUNITIES

Arthropods

Crustaceans



Arachnids and Insects



For other arachnids and insects, refer to *Pond Life* and *Insects* Golden Nature Guides

Data Sheet – "Going On An Algae Hunt"

Name _____

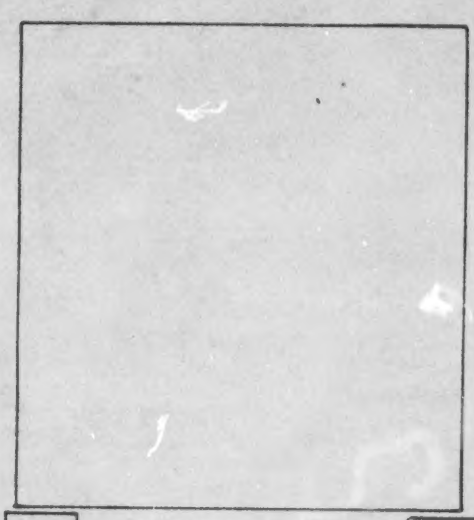
Date _____

Module _____

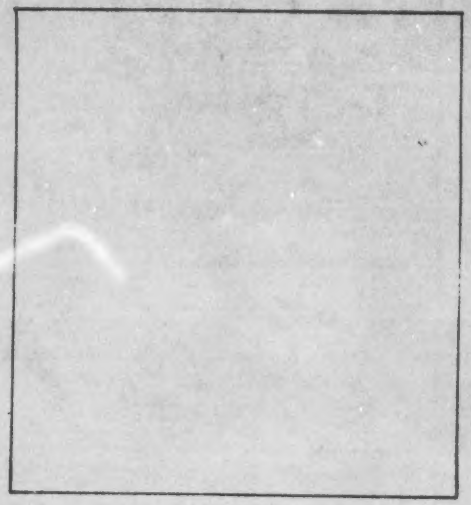
1. I collected algae from _____ (name the place) on _____ (date collected).

2. Name and sketch the algae you identify:

1. _____



2. _____



☐ ← checked by instructor → ☐

3. _____

☐

_____

41 Instructor's Signature

"THE BOTTLED-UP COMMUNITY"
(Building a Microcosm)

Background:

A microcosm is a properly balanced mini-pond (jar aquarium) that is sealed off and will sustain itself without additional care.

In a microcosm, as in any mini-community, organisms are *inter-dependent* (depend on each other). Plants manufacture food which is eaten by the fish. The fish gives off carbon dioxide which is used by plants in making food. A snail is a scavenger and will clean away wastes given off by fish and plants.

If you construct a balanced pond community, you can observe this interdependence throughout the normal life span of the fish.

Instructional Objectives:

1. Each student who chooses to do this activity, given a set of directions, will construct a balanced pond community that can be sealed off and sustain itself at least 8 weeks.

Materials:

1 gallon jar with lid
coarse gravel
sand
1 goldfish
1 small snail
water
water plants such as Elodea
wax
data sheet

Procedure:

1. Wash your jar and rinse it thoroughly so no soap is left behind.
2. Clean the gravel in running water. Add about an inch of gravel to the jar.
3. Cover the gravel with an inch or two of clean sand. You can clean the sand by placing in a pan and running a slow stream of tap water over it. Tilt the pan slightly and continue rinsing it until water running out of the pan is clear and free of debris.
4. Add water slowly until your jar is between two thirds and three fourths full. To fill the jar without disturbing the sand, place a double sheet of newspaper over the sand. Remove the newspaper after you finish pouring water. If you use tap water, you will need to boil it, let it stand overnight, and pour it back and forth to aeriate it before using it.
5. Root a few sprigs of Elodea or similar aquatic plants in the sand.
6. Put a goldfish and a small snail in the jar.
7. If you have a properly balanced community you should be able to seal it off and it will be self-sufficient. Screw the lid tightly onto your jar and seal it with wax.
8. Set your microcosm where it will receive strong light, but not direct sunlight. (Direct sunlight will cause algae to grow).
9. Record the date you completed your microcosm on your data sheet and continue to record observations every few days for the next 8 weeks or until the fish dies.

Data Sheet – "The Bottled-Up Community"

Name _____

Date _____

Module _____

Date	Observations

Instructor's Signature

"BOTTOMS UP!"

Background:

In every community plants and animals are adapted to their particular environment. As you study a lake, you will find that some of the organisms found in a pond and in a stream are not found in the lake. You will also find organisms in the lake that aren't found in the other freshwater communities. The environment of a deep lake is different from a still pond or a swiftly moving stream. In a pond there is very little water movement. Since ponds are fairly shallow their temperature remains fairly uniform throughout. Streams have a great deal of water movement and are usually much cooler than ponds due to the constant movement.

The motion of water under the surface of a deep lake is not too apparent, but patterns of water movement do occur. This is due to differences in water temperature near the lake surface and near the lake bottom.

This activity will help you to learn about temperature and water movement in a lake. You then should be able to better understand how these differences from a pond and stream result in some differences in the organisms that live in a lake. Read pp. 16-21 in *Life—Its Forms and Changes* for further background for this activity.

Instructional Objectives:

1. Each student will correctly sketch the movement of water that results when: (a) hot water is put into cold water; (b) cold water is put into hot water.
2. Each student will correctly explain where water temperatures of a deep lake are coolest during the summer.
3. Each student will describe the water movement of a deep lake that results from cooling the surface water.

Materials: Each group of students will need:

1 glass or beaker
1 forceps
1 vial
1 washer or suitable weight
1 eye dropper
food coloring
hot water
cold water

Procedure:

A. 1. Drop the washer into the bottom of the vial.
   2. Squeeze 2 drops of food coloring into the vial.
   3. Fill the *vial* with *hot water.* Use your eye dropper to add drops of hot water until your vial is completely filled.
   4. Fill your *glass* two thirds full of *cold water.*
   5. Use forceps to hold the wall of the vial. Carefully and slowly lower the vial into the glass of water.
   6. Let the vial rest on the bottom of the glass. Remove the forceps and observe what happens.
   7. Draw a sketch showing what happened to the colored water in the vial on your data sheet.

B. 1. Follow the same procedure as in part A, but this time put *cold* water in the *vial* and *hot* water in the *glass.*
   2. Draw a sketch showing what happened in the space provided on your data sheet.

C. 1. Answer the questions on your data sheet.
   2. When you have finished the questions, have your activity checked by your instructor.

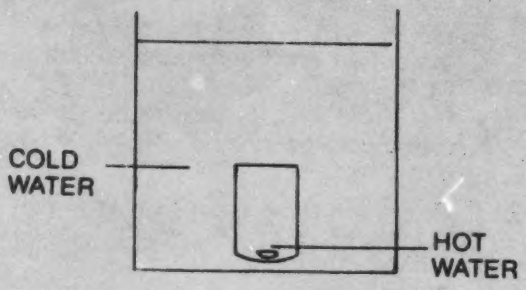
Data Sheet – "Bottoms Up"

Name _____

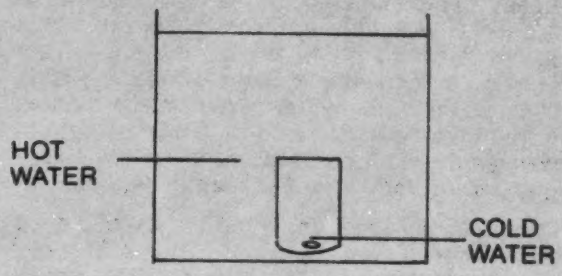
Date _____

Module _____

A.



B.



C. 1. What happened to the water in the vial in part A? _____

_____

2. What happened to the water in the vial in part B? _____

_____

3. Which is heavier, cold water or hot water? _____

_____

4. Which would contain more molecules, a vial full of hot water or a vial full of cold water? _____

_____

5. Where would you find more variation in temperature, in a shallow pond or a deep lake? _____

_____

6. In summer, are water temperatures cooler near the surface of a deep lake or near the bottom?

_____

7. Why won't you find living green plants at the bottom of a deep lake? _____

_____

_____

_____

continued

8. In the fall, as the air temperature becomes cooler, the surface water in a lake also becomes cooler.

a. What happens to this cooler water? _____

_____

_____

b. How does this affect the movement of water in the lake? _____

_____

_____

_____

_____

Instructor's Signature

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The Lake

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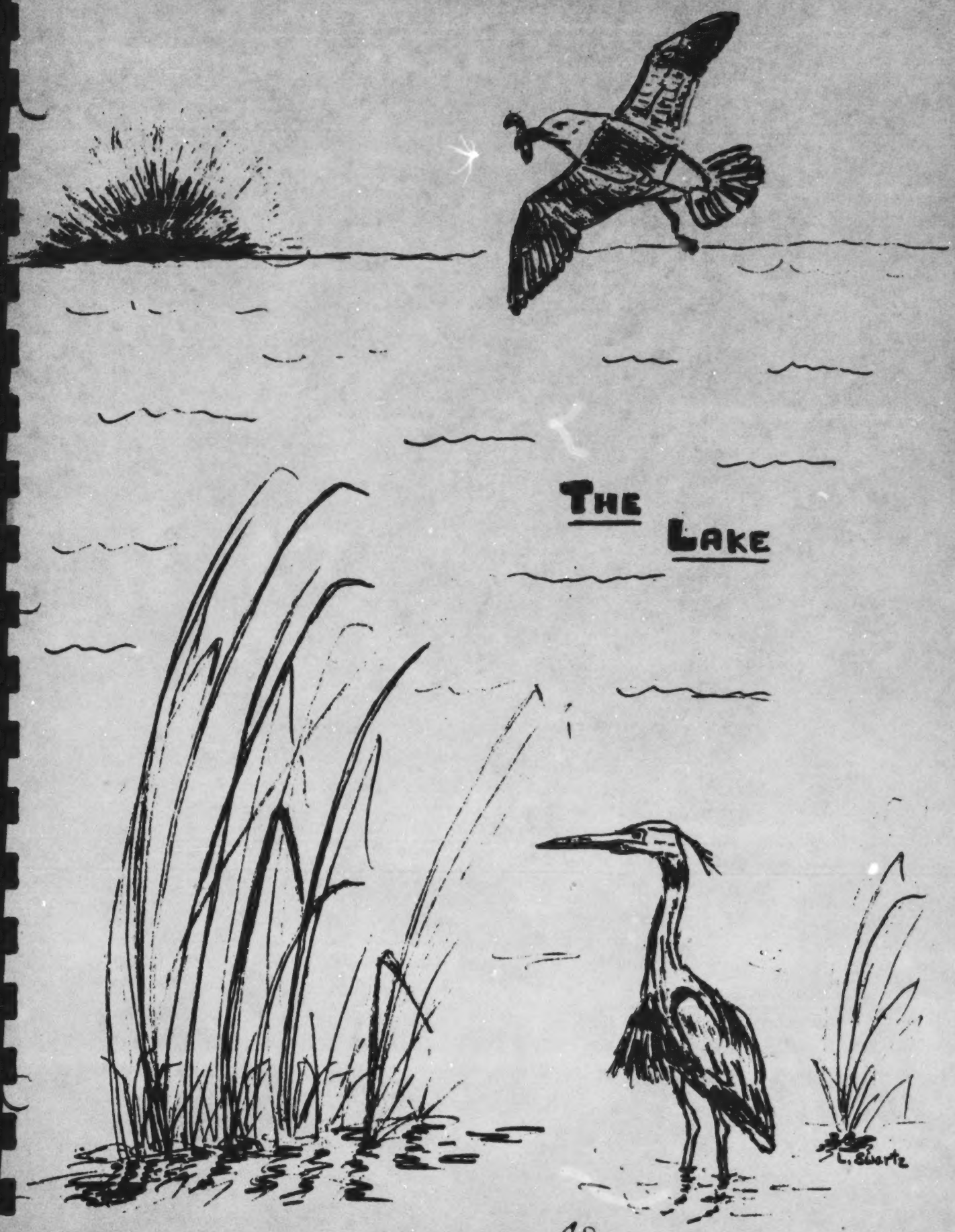
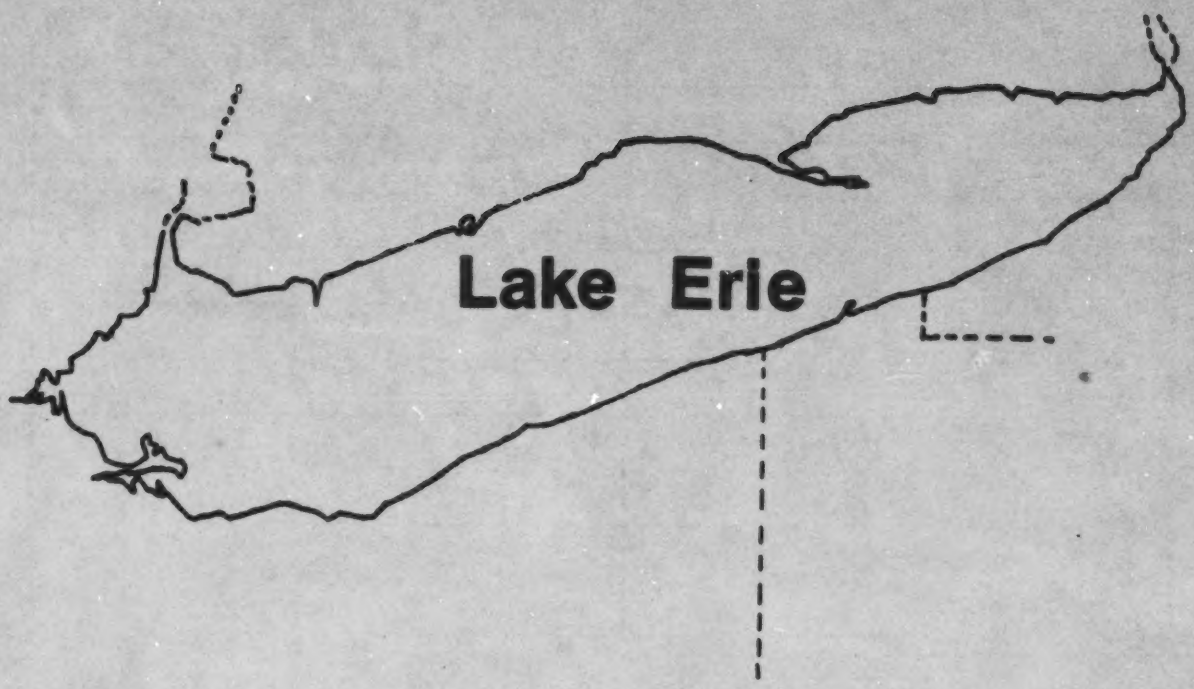

THE LAKE
L. Swartz

FRESHWATER COMMUNITIES – "THE LAKE IS ERIE"



Background:

You might think of a lake as a large pond. A lake differs from a pond in that a pond is shallow enough for rooted plants to grow entirely across it, while in a lake the water is too deep for plants to grow except around the shore.

You might expect to find the same plants and animals in a lake as those you found in a pond. Take a look at a lake to see for yourself.

Instructional Objectives:

Through observation each student will compare a pond community to a lake community with respect to:

1. Water movement
2. Type of life found in each
3. Depth of each

Materials:

Lake Data Sheet

"Pondering A Pond" Data Sheet (completed copy)

Lake Erie

Pencil

Keys to the Common Animals of the North Central States – Eddy & Hodson

Field Guide to the Birds – Roger T. Peterson

The follwing *Golden Nature Guides:*

Fishes – Zim & Shoemaker

Insects – Zim & Cottam

Reptiles & Amphibians – Zim & Smith

Spiders & Their Kin – Levi

Procedure:

1. Walk along the shore of Lake Erie. Observe any traces of life you find. Record the name of the organism and the place you found it on your lake data sheet (along the high water line, in the air, in the gravel or sand, on the beach, or in the water.)
2. Answer the questions on the lake data sheet. You may need to look at your completed "Pondering A Pond" data sheet to help answer some of the questions.

Data Sheet—"The Lake is Erie"

Name _____

Date _____

Module _____

ORGANISM	WHERE FOUND
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

1. Which is deeper, the pond you observed or the lake? _____

2. Describe the action of the water in the pond you observed: _____

_____

3. Describe the action of the water in the lake: _____

_____

4. Which organisms did you observe in both a pond community or a lake community? _____

_____

_____

_____

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Continued

5. Which organisms did you observe in the lake community but not in a pond community?_____

_____

_____

6. Which organisms did you observe in a pond community but not in a lake community?_____

_____

_____

_____

7. Where did you observe more kinds of plants, in a pond or a lake?_____

_____

8. Where did you observe more kinds of animals, in a pond community or a lake community?_____

_____

9. Why do you think there were more plants and animals in the pond community than in the lake community?_____

_____

Instructor's Signature

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"DON'T KNOCK THE HACH KIT"

Background:

Refer to "Don't Hock My Hach Kit". The purpose of this investigation is to study the quality of water in a lake.

Instructional Objectives:

At the end of this activity you should be able to use a Hach Kit and successfully determine the nitrates, nitrites, D.O. and pH of a Lake Community. With the aid of a thermometer, you should be able to determine the temp. of the water.

Materials:

1. Collecting bottles
2. waders
3. Hach Kit
4. thermometer
5. data sheet

Procedure:

1. Randomly choose sites along the lake so you sample water at the edge of the lake, ankle deep, and knee deep to waist deep.
2. At each site take water samples from the surface and, if possible, half way down and near the bottom.
3. Record the temperature of each sample.
4. Place the samples in properly labeled jars and take the jars to the lab for testing. Do the D.O. test at the lake site.
5. In the lab use the Hach Kit and follow the procedure for testing for each substance.
6. Determine average values for samples taken at ankle deep and knee deep to waist sites.
7. Complete the data page.

Data Page—"Don't Knock The Hach Kit"

Name_____

Date_____

Module_____

Site	Nitrate	Nitrite	DO	pH	Temp.
Edge					
Ankle Deep					
Top					
Middle					
Bottom					
Average					
Knee Deep to waist					
Top					
Middle					
Bottom					
Average					

SAFE LEVELS	<10ppm	<10ppm	>5.0ppm	8.5-6.5

Complete the following chart using a + if the substance falls within the safe level and a − if it does not.

Site

Site	Nitrate	Nitrite	DO	pH	Temp.
Edge					
Ankle Deep					
Knee Deep to waist					

_____

Instructor's Signature

THE STREAM

"LET'S GET OUR FEET WET"

Background:

Rocky River consists of two major branches—the East Branch and the West Branch. The West Branch originates in Medina County. The East Branch originates in Summit County, Medina County and Cuyahoga County. They join approximately eight miles (12.8 km) south of the river's mouth on Lake Erie. This joining occurs at Little Cedar Point.

Instructional Objectives:

At the end of this activity, you should be able to record general observations about:

1. Animal life of the Rocky River's Branches
   a. birds
   b. fish
   c. insects
   d. amphibians
   e. crustaceans
   f. mollusks
   g. mammals
2. Physical properties of the Rocky River's branches
   a. turbidity
   b. velocity
   c. river bed
   d. oil in the river
   e. width of the river

Materials:

1. *Field Guide to the Birds*—Roger T. Peterson
2. *Taxonomic Keys to Animals* (Eddy & Hodson)
3. Dip net
4. Data sheet

Procedure:

Walk up both branches of the river for about .4 km and observe the following:

1. Evidence of bird life.
2. Evidence of fish life.
3. Evidence of insect life both above and within the water.
4. Evidence of crustaceans.
5. Evidence of amphibians.
6. Evidence of mollusks.
7. Evidence of mammals.
8. Turbidity of the water (muddy, clear).
9. Velocity of the water (fast, slow).
10. Evidence of boulders in the river (where did they come from?)
11. What kind of river bed is there? (shale, gravel, sand, mud).
12. Evidence of oil in the river.
13. Approximate width of the river.
14. Complete the data page by recording different types of organisms seen and recording observations of physical properties of the rivers.

Data Page—"Let's Get Our Feet Wet"

Name_____

Date_____

Module_____

Name the types of organisms and describe the physical properties of the river observed in each area.

	West Branch	East Branch	Combined Branches
Bird life			
Fish life			
Insect life above water			
Insect life in water			
Amphibians			
Crustaceans			
Mollusks			
Mammals			
Boulders			
River bed			
Oil			
Width			
Turbidity			
Velocity			

_____

Instructor's Signature

WATER CHEMISTRY OF A STREAM

Background:

The two branches of Rocky River carry wastes (effluent) from Berea, Middleburg Heights, Strongsville, Medina, North Royalton, and Hinckley. This effluent plus normal run off from surrounding land adds to the chemistry of the river. The purpose of this activity is to carry out water chemistry analyses (using the Hach Kit) of the West Branch, East Branch, and where the two branches join at Little Cedar Point. We should be able to determine whether one branch of the river has a higher quality than the other, and how the quality of one affects the quality of the other.

Instructional Objectives:

At the end of this activity you should be able to:

1. Use a Hach Kit to determine the amounts of nitrates, nitrites, temp., D.O., pH of the two branches of Rocky River and of where they join.
2. State which branch has a higher quality of water by comparing your data with recommended levels.

Materials:

1. Sampling bottles
2. Hach Kit
3. Thermometers
4. Data page

Procedure:

1. Randomly pick a site at each branch of the stream and a site after the two branches come together. Collect a sample of water at each site.
2. Record the temp. of each sample of water.
3. Using the Hach Kits, test for D.O. at each site. Return to the laboratory for the rest of the chemical tests.
4. Run tests for nitrates, nitrites, D.O., and pH following the instructions on the Hach Kit.
5. Fill in the data page.

Data Page—Water Chemistry of a Stream

Name _____

Date _____

Module _____

Name of Stream _____

Nitrate _____

Nitrite _____

D.O. _____

pH _____

Temp. _____

Name of Stream _____

Nitrate _____

Nitrite _____

pH _____

Temp. _____

Name of Stream _____

Nitrate _____

Nitrite _____

D.O. _____

pH _____

Temp. _____

_____

Instructor's Signature

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Question – Water Chemistry of a Stream

Name _____

Date _____

Module _____

Recommended levels for various substances are:

Nitrates and Nitrites ..... Less than 10 ppm
Dissolved Oxygen ..... Not less than 5.0 ppm
pH ..... Between 8.5 and 6.5

1. Does the east branch of Rocky River not meet any of these criteria? _____

If not, which ones? _____

_____

_____

_____

2. Does the west branch of Rocky River not meet any of these criteria? _____

If not, which ones? _____

_____

_____

_____

3. Is there any evidence that the quality of one branch influences the quality of the other? Explain

_____

_____

_____

_____

_____

_____

_____

_____

_____

Instructor's Signature

DIVERSITY INDEX OF A STREAM

Background:

The quality of water in a stream will, in part, determine the type of life found in the stream. This activity enables the student to determine what the species population of macroinvertebrates in a stream are. The student may also determine, by investigation, if the diversity index changes as he samples three different streams:

1. Rocky River West Branch
2. Rocky River East Branch
3. Where the two branches come together at Little Cedar Point

Instructional Objectives:

At the end of this activity you should be able to:

1. Determine a diversity index of a stream.
2. Correctly use a Surber sampler.

Materials:

1. Surber sampler
2. 3 one-gallon bottles
3. White bottomed pan
4. Data Sheet

Procedure:

1. Choose a site at random along each stream. At each site take three samples such that the area is well covered. Water should not be too deep or too shallow or too fast running. Avoid rocks; find gravelly bottom with handsized stones or little larger.
2. At the chosen sites, place the Surber sampler so that it will trap macroinvertebrates that have been loosened from upstream. Disturb the bottom by moving stones upstream from the screen.
3. Remove the organisms from the screen, placing them in a suitable container.
4. In the lab, place the specimens in white bottomed pan; separate them as to kinds and count each kind.
5. Prepare a diversity index for each site. See "Diversity of a Pond" for procedure on how to prepare a diversity index.
6. Complete data page.

Data Page 1 – Diversity Index of a Stream

Name _____

Date _____

Module _____

WEST BRANCH		
Organism Number	Group	Run

EAST BRANCH		
Organism Number	Group	Run

COMBINED BRANCHES		
Organism Number	Group	Run

DIVERSITY INDEX

West Branch _____

East Branch _____

Combined Branches _____

_____

Instructor's Signature

Data Page 2 — Diversity Index of a Stream (cont'd)

Name _____

Date _____

Module _____

Questions:

1. What was the dominant organism of each stream? (common name)

   West Branch _____

   East Branch _____

   Combined Branch _____

2. Was there a difference in diversity among the three streams?

   _____

3. If there was a difference in diversity, explain why _____

   _____

   _____

   _____

   _____

   _____

_____

Instructor's Signature

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FRESHWATER COMMUNITIES – "ADAPTING TO THE STREAM OF LIFE"

Background;

Streams, ponds and lakes all contain fresh water. Streams differ from ponds and lakes in that:

—their water is cooler

—their water is fast moving

—their water contains more dissolved oxygen due to the movement causing air to mix with the water (aeriation).

If you took a lily pad or some duckweed from a pond and placed it in a stream, it would not live long. On the other hand, you will find organisms in a stream (such as a caddisfly larva) that you didn't find in a pond. This is because organisms are *ADAPTED* to their particular environment.

An *ADAPTATION* is a feature which makes it possible for an organism to live in its environment. A fish will not live long if kept out of water because it is not adapted for breathing out of water.

In this investigation you will be looking at the organisms that live in a stream community. Try to note their shape or any other feature they have that helps them to survive in a stream.

Instructional Objectives:

1. Each student will locate and identify at least 8 different organisms that live in the stream community.
2. Each student will name at least two organisms he found in a pond community, but not in a stream community and adaptations to a pond for each organism named.
3. Each student will name at least two organisms he found in a stream community but not in a pond community.
4. Each student will name at least 2 adaptations of organisms to a stream.

Materials:

1. Dip nets
2. Collecting jars and vials
3. Knapsacks
4. Stream data sheets
5. Kitchen strainers
6. Seine net (optional)
7. Sorting trays, dishpans, or pails
8. Old tennis shoes, boots, or waders
9. Reference books for identification of organisms

A. *Field Book of Ponds and Streams*—Ann Morgan
B. *Keys to the Common Animals of the North Central States*—Eddy and Hodson
C. *Fishes*—Zim and Shoemaker
D. *Insects*—Zim and Cottam
E. *Spiders and Their Kin*—Levi
F. *Reptiles and Amphibians*—Zim and Smith
G. *A Field Guide to the Birds*—Roger Troy Peterson

Procedure:

1. Observe the banks and trees around the stream. Record any organisms you see and their location on your data sheet.
2. Wade into the stream. Look for organisms on the surface of the water, under rocks and logs, on the stream bottom, swimming in the water, and in the air above the stream. Note any features of organisms that help them live in the stream.

   One animal you should find attached to rocks is a caddisfly larva. If you find a little case made from sticks or stones, detach it from the rock or stick that it is on and squeeze it gently. If a caddisfly larva lives inside it, it will crawl out the open end of the case.
3. Use net, kitchen strainers, jars, and hands to catch any of the animals you see. You may want to temporarily put the animal in a pail or sorting tray to get a better look at it, and to let others see it.
4. After you have identified the animals you catch, return them to their stream home.
5. Record the organisms you find and their location on your data sheet. If you noted a special adaptation of the organism, record it also.
6. Answer the questions on your data sheet. When they are completed, have your data sheet checked by your instructor.

Name _____

Data Sheet

Date _____

"Adapting to the Stream of Life"

Module _____

Organism	Where Found (surface, under rocks, etc.)	Adaptation To A Stream

1. Which organisms live under submerged rocks? _____ _____

_____

2. Which organisms are free-swimming? _____

_____

3. Which organisms did you find attached to rocks or plants? _____

_____

4. Which living things did you find on the surface of the water? _____

_____

5. Which living things did you find in the air or in the trees around the stream? _____

_____

6. Which living things did you find on the bank or shallow part of the stream? _____

_____

7. Name at least two organisms you found in the pond, but not in the stream. (You may use data sheet from "Pondering a Pond" if you need to)

_____ _____

8. Name at least two organisms you found in the stream, but not in the pond.

_____ _____

9. How does the oxygen supply of a stream compare with that of pond water? (See data sheets from "Don't Hock My Hach Kit" and "Water Chemistry of a Stream")_____

_____

10. Were most of the organisms you saw fast-moving or slow-moving?_____

_____

11. Which organisms would require more oxygen, slow-moving ones or fast-moving ones?_____

_____

12. How does the movement of water of a stream compare with movement of a pond?_____

_____

13. Why won't you find any lilypads or duck weed in a stream?_____

_____

14. One of the animals you should have found is the caddisfly larva. How is the caddisfly larva adapted to life in the fast-moving water of a stream?_____

_____

15. Name at least two organisms you found in a pond, but not in a stream.

_____ _____

Name an adaptation to a pond for each of these organisms.

ORGANISM	ADAPTATION

16. Name at least two organisms you found in a stream, but not in a pond.

_____ _____

Name an adaptation to a stream for each of these organisms.

ORGANISM	ADAPTATION

_____

Instructor's Signature

TERRESTRIAL

THE WOODLAND

"WHAT'S FOR SUPPER?"

Background:

Organisms must have food to produce energy to keep alive. Green plants make their own food. They are called *PRODUCERS* and are the first link in any food chain. Organisms that cannot make food must obtain their energy by eating other organisms. These organisms are called *CONSUMERS*. Consumers may be divided into a number of different groups based on how they get their food and what type of food they eat.

Herbivores are the plant-eaters. They usually eat large amounts of food because pound for pound plant substances are not as nourishing as animal tissues. Herbivores include deer, rabbits, squirrels, woodchucks and many insects. These animals are the second link in a food chain.

Carnivores are meat-eaters. Predators (animals that eat other animals) such as hawks, foxes, and snakes are carnivorous. A few plants (Venus flytrap and pitcher plant) are carnivorous, although they are green and make some of their own food. Spiders, frogs, and some insects are among small carnivorous animals.

Animals that eat both plants and animals are *Omnivores*. Omnivores include pigs, man, house mice and house rats. Omnivores have an advantage over herbivores and carnivores since they can eat almost any kind of food available. When hunger faces organisms they might cross lines. Carnivorous animals might become herbivores and visa versa.

Some plants and animals are *Parasites*. These organisms live *on* or *in* other *living* things. They get food from their victims (host) without giving anything in return. A parasite does not usually kill his host (he would loose his happy home) but he certainly doesn't do him any good. Parasitic plants include dodder vine and some fungi. Animal parasites include many roundworms and flatworms, and some insects, and leeches. Even a few vertebrates such as the lampreyeel may be classified as parasites.

Some plants feed on dead and decaying plant and animal tissues. Bacteria, many fungi (such as mushrooms), and a few flowing plants (such as Indian pipe) belong to this group. They are called *Saprophytes*. Saprophytes contain no chlorophyll, therefore they are unable to make their own food.

Animals that feed on dead and decaying plant and animal tissue are called *Scavengers*. Scavengers and saprophytes act like vacuum cleaners in that they help clean up debris left behind by other organisms in the environment. Scavengers include snails, many insects, millipedes, and sowbugs.

Instructional Objectives:

1. Each student will observe at least 10 organisms and identify each as a producer, a herbivore, a carnivore, an omnivore, a parasite, a saprophyte, or a scavenger.
2. Each student, given a list of 12 organisms, will identify each as a producer, herbivore, carnivore, omnivore, parasite, saprophyte, or scavenger.

Materials:

1. data sheet
2. hand lenses
3. pencil
4. taxonomic keys

Procedure:

1. All the food groups described above are likely to be represented in any community. As you walk through a woodland community, look at various organisms and try to observe how they get their food.
2. As you observe each different kind of organism, both plants and animals, record it on your data sheet and place a check in the column that best describes how the organism obtains its food.
3. You will find a list of common plants and animals on the second page of your data sheet. Name the correct food group for each.
4. Have your instructor check your data sheet and sign it.

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"What's for Supper?" Data Sheet

Name _____

Date _____

Module _____

	ORGANISM	PRODUCER	HERBIVORE	CARNIVORE	OMNIVORE	PARASITE	SAPHROPHYTE	SCAVENGER
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

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_____

Instructor's Signature

Name _____

Date _____

Module _____

Tell whether the following organisms are a producer, a herbivore, a carnivore, an omnivore, a parasite, a saprophyte, or a scavenger.

1. deer _____
2. millipede _____
3. spider _____
4. moss _____
5. frog _____
6. rabbit _____
7. mushroom _____
8. oak tree _____
9. dodder vine _____
10. shelf fungus _____
11. grasshopper _____
12. snail _____

_____
Instructor's Signature

WEATHER IN THE WOODS

Background:

Water vapor in the air is of extreme importance, since without it there could be no rain, no lakes, no rivers, no oceans, and no life. Where there is enough water vapor, and the soil is adequate and the climate favorable, we find many kinds of life. *Relative humidity* is a term which describes the amount of water vapor contained in the air at a given time compared to what the air is able to contain. A relative humidity of 90% indicates that the air contains 90% of the moisture that it can hold. The amount of water which the air can hold is dependent on the temperature of the air. Warm air can hold more moisture than cold air can hold.

Instructional Objectives:

At the end of this activity you should be able to:

1. Correctly define relative humidity.
2. Correctly use a sling psychrometer.
3. With the use of a sling psychrometer and a relative humidity table, correctly determine the relative humidity of a given area at a given time.
4. Determine the temperature of a given area at a given time.
5. Determine the wind direction with the use of a wind vane.
6. With the use of an anemometer, determine the wind speed.
7. Make correct general observations about sky conditions, (clear, cloudy, partly cloudy, raining, snowing, fog).

Materials:

1. Sling psychrometer
2. Wind vane and compass
3. Anemometer
4. Chart of relative humidities
5. Data page

Procedure:

On at least three different days:

1. Go into a dense woodland area and observe the sky conditions.
2. To determine relative humidity, take the sling psychrometer and whirl it over your head approximately a dozen times. Read the temperature of the wet bulb and the temperature of the dry bulb. By calculating the difference between the two readings and using the relative humidity chart you can determine the relative humidity.
3. Use the dry bulb reading for temperature.
4. Follow the directions on the anemometer to determine the wind speed.
5. Use the compass to determine which direction is north.
6. Set up the wind vane and note the direction of the arrow to determine wind direction.
7. Complete data page.
8. Complete the activity titled "Let's Meddle In A Meadow".

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CHART OF RELATIVE HUMIDITIES

Dry-bulb Reading	Difference between Dry-bulb and Wet-bulb Readings (Fahrenheit Degrees)																		
	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°
98°	96	93	89	86	82	79	76	72	69	66	63	60	57	54	52	49	46	44	41
96°	96	93	89	85	82	78	75	72	68	65	62	59	57	54	51	48	45	43	40
94°	96	93	89	85	81	78	75	71	68	65	62	59	56	53	50	47	44	42	39
92°	96	92	88	85	81	78	74	71	67	64	61	58	55	52	49	46	43	40	38
90°	96	92	88	84	81	77	74	70	67	63	60	57	54	51	48	45	42	39	36
88°	96	92	88	84	80	77	73	69	66	63	59	56	53	50	47	44	41	38	35
86°	96	92	88	84	80	76	72	69	65	62	58	55	52	49	45	42	39	36	33
84°	96	92	87	83	79	76	72	68	64	61	57	54	51	47	44	41	38	35	32
82°	96	91	87	83	79	75	71	67	64	60	56	53	49	46	43	40	36	33	30
80°	96	91	87	83	79	74	70	66	63	59	55	52	48	45	41	38	35	31	28
78°	95	91	86	82	78	74	70	66	62	58	54	50	47	43	40	36	33	30	26
76°	95	91	86	82	78	73	69	65	61	57	53	49	45	42	38	34	31	28	24
74°	95	90	86	81	77	72	68	64	60	56	52	48	44	40	36	33	29	26	22
72°	95	90	85	80	76	71	67	63	58	54	50	46	42	38	34	31	27	23	20
70°	95	90	85	80	75	71	66	62	57	53	49	44	40	36	32	28	24	21	17
68°	95	90	84	79	75	70	65	60	56	51	47	43	38	34	30	26	22	18	15
66°	95	89	84	78	74	69	64	59	54	50	45	41	36	32	28	23	20	16	12
64°	94	89	83	78	73	68	63	58	53	48	43	39	34	30	25	21	17	13	9
62°	94	88	83	77	72	67	61	56	51	46	41	37	32	27	23	18	14	10	5
60°	94	88	82	77	71	65	60	55	50	44	39	34	29	25	20	15	11	6	2
58°	94	88	82	76	70	64	59	53	48	42	37	31	26	22	17	12	7	2	
56°	94	87	81	75	69	63	57	51	46	40	35	29	24	19	13	8	3		
54°	93	87	80	74	68	61	55	49	43	38	32	26	21	15	10	5			
52°	93	86	79	73	66	60	54	47	41	35	29	23	17	12	6				
50°	93	86	79	72	65	59	52	45	38	32	26	20	14	8	2				
48°	92	85	77	70	63	56	49	42	36	29	22	16	10	4					
46°	92	84	77	69	62	54	47	40	33	26	19	12	6						
44°	92	84	75	68	60	52	45	37	29	22	15	8							
42°	91	83	74	66	58	50	42	34	26	18									
40°	91	82	73	65	56	47	39	30	26										
38°	91	82	72	64	56	46	38												
36°	90	80	71	62	54	46													
34°	89	79	69	62	54														
32°	89	78	68	61	48														
30°	88	76	66	56	47														
28°	87	75	65	53	43														
26°	86	73	63	50	38														
24°	85	71	60	47															
23°	85	70	58																
22°	85	69																	
21°	85																		

Data Page: Weather In The Woods

Name _____

Date _____

Module _____

Date	Temp.	Relative Humidity	Wind Direction	Wind Speed	Sky Conditions

1. Was relative humidity related to temperature?
2. Was relative humidity related to sky conditions?
3. Was relative humidity related to wind speed?
4. Was relative humidity related to wind direction?

_____

Instructor's Signature

"LEAFING THROUGH A WOODS"
(A Woodland Quadrant Study)

Background:

Living things are seldom found alone. They usually occur in groups. For example: a group of ants live in an ant hill; a group of earthworms live in a plot of soil; and a group of dandelions live in a lawn. A number of one kind of organism living in an area is a *POPULATION*. A group of populations living in the same place make up a *COMMUNITY*.

To describe a community accurately, you need to know what populations are present and the size (number) of each population. The populations present in the greatest numbers are the *DOMINANT* populations of a community. Dominant populations determine the activities and life patterns of an entire community.

In this investigation you will be working in teams of four to study the *populations* of a *woodland community*.

Instructional Objectives:

Each student will:

1. Help measure a woodland quadrant 3 meters x 3 meters.
2. Take part in a population count within a quadrant 3 meters x 3 meters.
3. Determine the dominant population of his given quadrant.
4. Compare population counts with other quadrant teams to determine dominant populations of the entire woodland area.

Materials:

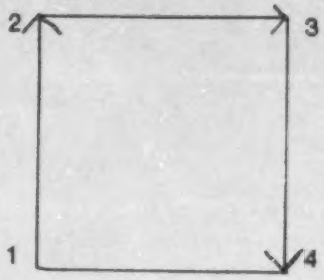
Each team will need:

1. string — about 13 meters long
2. 1 metric tape measure
3. 4 stakes
4. compass
5. data sheets
6. Reference books for identifying plants and animals:
   - A. *A Field Guide to the Birds* — Roger Troy Peterson
   - B. "Tree Finders"
   - C. *Flowers* — Zim and Martin
   - D. "A Key to Common Animals"
   - E. *Insects* — Zim and Cottam
   - F. *Spiders and Their Kin* — Levi, Levi and Zim
   - G. *Mammals* — Zim and Hoffmeister

Procedure:

With your team, measure off an area in the woods 3 meters by 3 meters. Use string and stakes to set the boundaries for your chosen area.

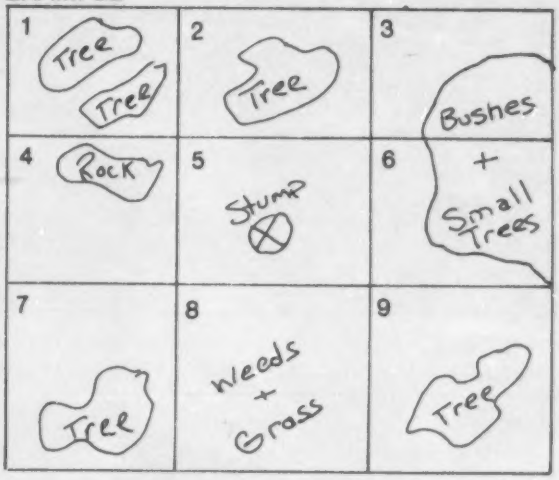
1. Begin by using your compass to find NORTH. Put a stake in the ground where you are standing and tie one end of the string to it.
2. Still facing North, measure off 3 meters.
3. Place a second stake in the ground and loop the string around the stake at the 3 meter mark.
4. Turn 90° to your right so you will be facing East.
5. Measure off another 3 meters.
6. Put another stake in the ground and loop the string around it as before.
7. Turn 90° to face South and repeat steps 5 & 6.
8. Turn 90° to face West and repeat steps 5 & 6. You should be back at your original stake.
9. Tie the free end of the string to your original stake. Your area should look like this:



Now let's see what life is within the area you have measured:

10. Use the diagram on your data sheet to make a rough map of this area, sketching obvious features such as big rocks, trees, stumps, etc.

EXAMPLE



11. Each member of your team should stand in a different section of your measured area to record as many organisms as you can observe.
12. Mark an "X" on the part of the diagram on your data sheet that corresponds to your point of observation.
13. For each kind of organism, note *where* it was seen, the *number* seen, the *activities* of the organism (running, sleeping, eating, etc.), and how the organism seems to affect other living things. Pay particular attention to the *zone* each organism occupies in the community. Some animals will be in the treetops. Others will be found crawling on the ground or hiding under leaves and rocks. Plants also occupy different zones within the community. Some (like trees) will extend many feet upward from the ground while others (like the mosses and fungi) will grow on rocks, on parts of trees, or only extend a fraction of an inch from the ground.
14. A chart like the one below has been provided on your data sheet to summarize your observations.

Organism	Location	Number Seen	Activities	Other Notes
Oak Tree	1, 2, 9	5	None	About 50 ft. tall & offers shade & home to animals
Tree Stump	5	1	None	Home for birds and Bugs—Fungi growing on it
Squirrel	1, 2	2	Running, Jumping, Eating acorns, Scolding	Nest in Oak Tree in Area 1

15. Answer the questions on your data sheet. Use your recorded observations to help you.
16. Have your instructor sign your data sheet.

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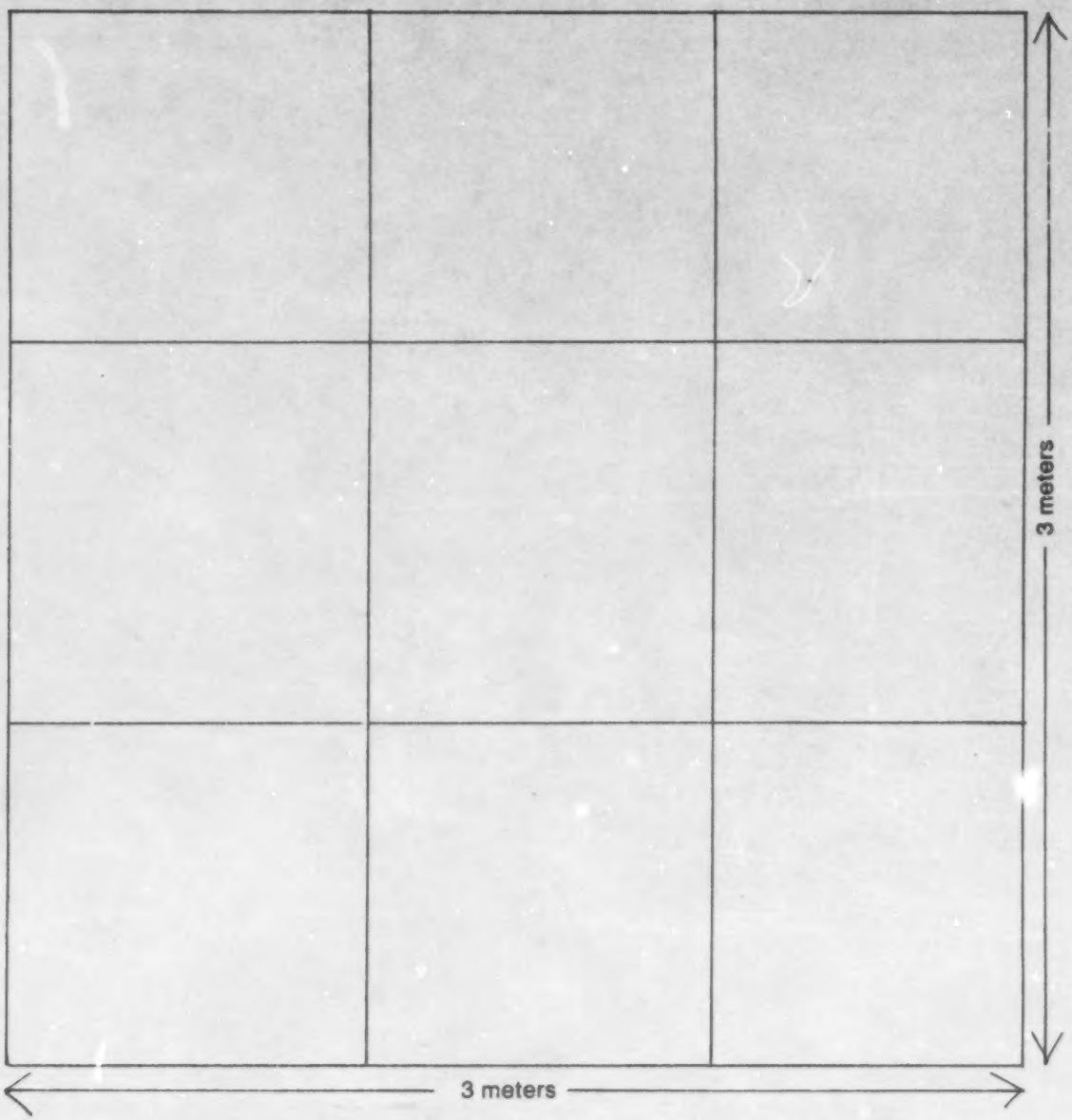
Data Sheet #1 "Leafing Through A Woods"

Name _____

Date _____

Module _____

#10 QUADRANT MAP



_____

Instructor's Signature

Data Sheet #2 — "Leafing Through A Woods"

Name _____

Date _____

Module _____

(13-14) POPULATION (ORGANISM)	QUADRANT LOCATION	POPULATION COUNT (Number Seen)	ACTIVITIES	OTHER NOTES

_____
Instructor's Signature

Data Sheet #3 — "Leafing Through A Woods"

Name _____

Date _____

Module _____

QUESTIONS TO ANSWER:

1. Which organisms did you see in the greatest numbers in your quadrant? _____

   How many did you see of each? _____

2. What were the dominant organisms in your quadrant? _____

3. Give three examples from your observations that show how a dominant population affects other populations within the woodland community. _____

4. Post the results from your population counts along with the results from the other teams.

5. Compare the results from your quadrant with those from other quadrant teams. What populations were dominant in their quadrants? _____

6. What are the dominant populations of the entire woodland community? _____

_____
Instructor's Signature

THE FOREST COMMUNITY – "THE LITTER IS BUGGED"

Background:

The special place where a plant or animal lives is called its *HABITAT*. We have studied several freshwater habitats of organisms (pond, lake and stream). We have also learned that some organisms are land dwellers. They may live under rocks, in trees, in the woods, or in the grass of a meadow. The soil itself is a habitat for many organisms. Scientists estimate that within topsoil there probably exist more organisms than in any other habitat on earth.

In this activity you will be examining the litter from a forest floor to find its inhabitants.

Hundreds of pounds of material fall onto a forest floor each year. The litter is first attacked by decomposers (fungi and bacteria). As the litter becomes softened and partially digested, it becomes usable food for the consumers. These tiny consumers are what you will be looking for during this experiment.

Instructional Objectives:

Each student will use a modified Berlese funnel to determine that soil is a habitat for many organisms.

Materials:

trowels or small shovels
plastic bags (food storage size)
large pieces of white cardboard or poster board
forceps
hand lenses
¼" hardware cloth (6" x 6" squares)
funnels, short stemmed
lamps
eyedroppers
petri dishes
microscopes
cover slips
jars (2 per team)
alcohol
copies of "A Key for Common Animals"

Procedure:

1. For this activity you will work in teams of four. Each team will need a plastic bag and a trowel or shovel to collect forest litter.
2. Scoop up enough forest litter and topsoil to half fill your plastic bag.
3. Place your soil sample in the center of a large sheet of white cardboard or poster board. Loosen the soil with your forceps and hands and spread it over your sheet of paper.
4. Use your forceps to pick out organisms you may find. A hand lens may help you locate some of the specimens.
5. Transfer the specimens to a jar containing 10 ml of alcohol for killing and preserving.
6. Label the second jar with the names of members of your team. Add a small amount of water to the jar.
7. Press a piece of hardware cloth into a funnel. Place the funnel in the jar containing water.
8. Place some of the forest litter that remains on your white paper in the funnel. Return the rest of your sample to the soil outside.
9. Set your experiment under a lamp and wait one day. The heat from the lamp will drive any living organisms downward toward the water in your collecting jar.
10. After your funnel experiment is set up, examine the specimens you placed in alcohol.
11. Answer the questions to Part I on your data sheet.
12. After one day, look at the water in the collecting jar that was placed under the lamp.
13. Pour some of the water into a petri dish.
14. Use an eyedropper to place a drop of water on a clean microscope slide.
15. Add a cover slip and examine your sample under low power with the microscope.
16. Draw what you see on the space provided on Part II of your data sheet.
17. Repeat steps (13 thru 16) for two more samples.
18. Compare your results with those of your classmates.
19. Answer the questions on Part II of your data sheet.
20. Answer the questions on Part III of your data sheet.

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"The Litter is Bugged" Data Sheet

Name _____

Date _____

Module _____

PART I — Organisms preserved in alcohol:

1. How many organisms did you find? _____

2. Are these animals vertebrates (with a backbone) or invertebrates (without a backbone)? _____

_____

3. What phylums of animals are represented by your specimens? (Use "A Key for Common Animals" to identify the phylum.)

_____ _____

_____ _____

_____ _____

4. To what phylum of animals do most of your specimens belong? _____

_____

PART II — Organisms collected from funnel:
Draw the organisms you see:

Sample 1

Sample 2

Sample 3

_____
Instructor's Signature

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Name _____

Date _____

Module _____

1. What phylums of animals are represented in these samples?

_____

_____

_____

2. How many organisms did you collect in your jar? _____

3. In what habitat do these organisms live? _____

_____

PART III

1. What material were you examining in Part I and Part II?

_____

_____

2. You looked at some organisms in Part I and Part II. Where did they come from? _____

_____

_____

3. How many different organisms did you see in Part I and Part II? _____

_____

_____

_____

4. State what you learned in this experiment about soil and organisms. _____

_____

_____

_____

_____

Instructor's Signature

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"DO YOU PINE FOR A FOREST"

Background:

"If you've seen one tree, you've seen them all." Is this statement true or false? Even to the most casual observer this is a false statement. We certainly can note a difference between a pine tree and an oak tree. One has needles and cones, the other has broad leaves and acorns. Trees which have leaves modified as needles and produce cones are called "conifers" or gymnosperms. Those which have broad leaves and produce a seed with a cover on it are called angiosperms. Among the conifers and among the angiosperms there are characteristics which enable a person to tell a pine from a spruce or an oak from a maple.

Instructional Objectives:

At the end of this activity you should be able to use a dichotomous key and correctly identify 10 trees on the basis of their leaf structure.

Materials:

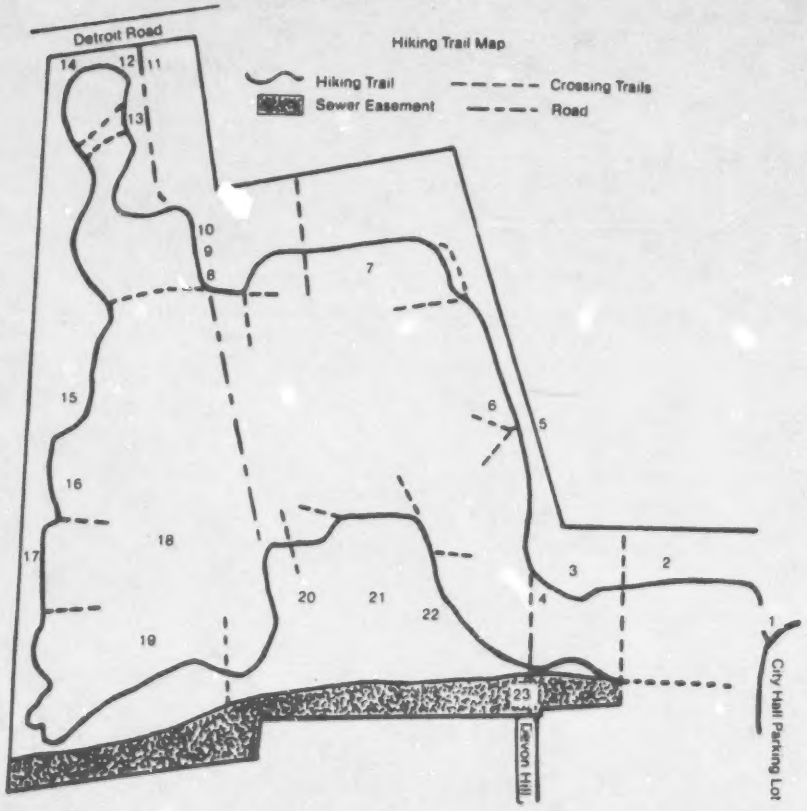
1) Outdoor Educational Center
2) a dichotomous key to trees
3) list of trees on the site
4) leaf press
5) data page

Procedure:

1) Go to the Outdoor Educational Center to observe the leaves of trees. Some of the trees have numbers on them. Pick a leaf from a numbered tree and use the dichotomous key to determine what the tree is. You can check your answer against the list of trees at the site to see if you are correct. Identify 10 different trees.
2) Work in teams to obtain specimens of:
   1. simple leaves (opposite and alternate), and compound leaves (opposite and alternate).
   2. leaves with lobes and without lobes.
   3. leaves with smooth margins and leaves without smooth margins.

   Use a leaf press to make permanent displays of your leaf collection. Identify the leaf by name and tell whether it is simple, compound, lobed, non-lobed, etc.
3) Complete data page.

Rocky River City School District
Outdoor Education Center



Areas of Interest

1. Entrance—City Hall
2. Mixed Forest
3. Grape Vine Canopy
4. Intermediate Forest
5. Condominium Construction
6. Cultivated Area In Early Stages of Recovery
7. Intermediate Forest
8. Area Where Rest Room Was Burned by Vandals
9. Large Poison Ivy Vines Cross Section Shows Growth Rings
10. A Backward 4
11. Entrance—Detroit Road
12. Scouring Rush
13. Old Well
14. Sugar Maples
15. Shelter
16. Black Locust Canopy
17. Old Chestnut Post
18. Mowed Area
19. Intermediate Forest
20. Marsh Area
21. Mowed Area
22. Marsh Area
23. Entrance—Devon Hill

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ROCKY RIVER OUTDOOR EDUCATION CENTER—TREES ALONG THE HIKING TRAIL

1. Swamp white oak
2. Pin oak
3. Silver maple
4. Silver maple
5. White ash
6. Red oak
7. Sugar maple
8. American beech
9. White oak
10. White ash
11. American beech
12. American beech
13. Bitternut (pig nut)
14. Cucumber tree
15. Cucumber tree
16. Tulip poplar
17. Sassafras
18. Sugar maple
19. Shagbark hickory
20. American linden
21. Shagbark hickory
22. Pin oak
23. Tulip poplar
24. Muscle wood
25. Black oak
26. Pin oak
27. White ash
28. White ash
29. Pin oak
30. American elm
31. Quaking aspen
32. Red oak
33. Gray birch
34. Pin oak
35. Sweet cherry
36. Pussy willow
37. Wild black cherry
38. Apple
39. Box elder
40. American elm
41. Black locust
42. Box elder
43. Staghorn sumac
44. Box elder
45. Box elder
46. Norway maple
47. Wild black cherry
48. Sassafras
49. White ash
50. Wild black cherry
51. Sweet cherry
52. Wild black cherry
53. Sweet cherry
54. Catalpa
55. Red maple
56. American elm
57. Butternut
58. White ash
59. Sweet cherry
60. Wild black cherry
61. American elm
62. Mulberry
63. Black walnut
64. Mulberry
65. Black walnut
66. Sweet cherry
67. Sassafras
68. White ash
69. Sugar maple
70. Black walnut
71. Sugar maple
72. Sugar maple
73. Black walnut
74. Pin oak
75. Catalpa
76. American elm
77. Sweet cherry
78. White pine
79. Red maple
80. Hawthorn
81. Black walnut
82. White ash
83. Sweet cherry
84. Wild black cherry
85. Norway maple
86. Black locust
87. Black locust
88. Norway maple
89. Norway maple
90. Wild black cherry
91. Black locust
92. Norway maple
93. Mulberry
94. Mulberry
95. Black locust
96. Gray birch
97. American elm
98. Pin oak
99. Norway maple
100. Staghorn sumac
101. Cut leaf maple
102. Pin oak
103. White oak
104. American elm
105. White ash
106. American elm
107. Apple tree
108. Eastern cotton wood
109. Eastern cotton wood
110. Mulberry
111. Black locust
112. Staghorn sumac
113. Sassafras
114. Sour gum
115. Sweet gum
116. Black ash
117. White ash
118. Staghorn sumac
119. Mountain ash
120. Crab apple
121. Hawthorn
122. American elm
123. Red maple
124. Hawthorn
125. Willow
126. Quaking aspen
127. White ash
128. Sour gum
129. Eastern cotton wood
130. American linden

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Data Page—"Do You Pine For A Forest"

Name _____

Date _____

Module _____

Fill in the chart by placing an X in the boxes opposite the characteristics that apply to each tree.

	Maple	Oak	Ash	Buckeye	Elm	Sassafras
Alternate leaf arrangement						
Opposite leaf arrangement						
Single leaf						
Compound leaf						
Lobed leaf						
Non-lobed leaf						

Tree Number	Name of Tree
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

Place the numbers and names of the trees you have keyed out in the chart at the left.

_____

Instructor's Signature

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"IS THERE A SKUNK IN THE WOOD PILE?"

Background:

A community is defined as the association between plants and animals. It may be as simple as one deer and one tree or as complex as a whole forest. This activity is meant to introduce you to a community that might be new to you: a rotting log community.

When a tree is living it takes CO_2 from the air and water from the soil and combines these materials to make glucose. As a by-product it gives off oxygen which is necessary for animals, including man, to live. The tree can take the glucose and combine it into other sugars. The tree also produces starches, proteins, oils and acids.

When gasses enter the stomata of the leaves; when a woodpecker drills for insects; when a limb is damaged by wind, lightning, frost or ice; or when an insect eats its way into the tree, fungi may enter the tree. This could be the beginning of the death of the tree. Benton and Werner (*Workbook for Field Biology and Ecology*, pp. 137-8) have classified rotting logs into four stages: the standing dead tree, the newly fallen tree, the log rotting on the inside but hard on the outside, and the completely rotten log.

Even before the dead tree falls it may serve as a home for birds, squirrels, chipmunks and a host of other animals. Once a tree has fallen it is still useful. All of the products that the tree has made are still present, and for life to continue, these products must be returned to the soil.

The community within a log consists of: consumers which live on the log's materials, scavengers which live on refuse, predators which live on other animal life, and decomposers which help to decay organic material and return the nutrients to the soil. There are also transient animals, such as rabbits, which use the log for shelter only.

The following lists of animals and plants will give you an idea of some of the life you may find in a log.

DECOMPOSERS
fungi
bacteria
slime molds

CONSUMERS
engraver beetle
click beetle
termites
carpenter ants

SCAVENGERS
pillbugs
millipedes
slugs
earthworms

PREDATORS
woodpeckers
centipedes
spiders
mites
salamanders

A food chain in a log community might be as follows:

log → termite → woodpecker
log → carpenter ant → woodpecker

Notice that the termite and carpenter ant occupy the same step or link in the food chain. Such a position would be called a *NICHE* (nich). Another example would be:

log → termite → woodpecker
log → termite → salamander

Now the woodpecker and salamander occupy the same niche. A food web is composed of many food chains and serves as an illustration of the many niches there are in a community.

Instructional Objectives:

At the end of this activity you should be able to:

1. Correctly classify the stages of rotting log according to Benton and Werner.
2. Give examples of:
   2 decomposers
   2 consumers
   3 predators
   3 scavengers
3. Correctly define a niche and contrast with the term "habitat".
4. Correctly construct a food chain and a food web.

Materials:

1. Data page
2. nail
3. rotting logs

Procedure:

1. Choose two rotting logs that are in different stages of decay.
2. Observe the logs and look for evidence of life within the log.
3. If you move any part of the log be sure to replace it as you found it.
4. Complete data page 1 for each log.
5. Complete data pages 2 and 3.

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Data Page 1 — "Is There a Skunk in the Woodpile?"

Name _____

Date _____

Module _____

Stage of decay _____

	YES	NO
1. Is the bark still on the log?		
2. Can a nail be pushed into the wood?		
3. Are borings apparent in the wood or on the surface?		
4. Are any birds or mammals using the log as a home?		
5. Is the tree standing or fallen?		
6. Have you observed any invertebrates?		
7. Have you observed any salamanders?		
8. Have you observed any frogs or toads?		
9. Are any mammal runways apparent?		

10. List all organisms (plant and animal) seen:

ORGANISM (common name)	Estimation of number

_____

Instructor's Signature

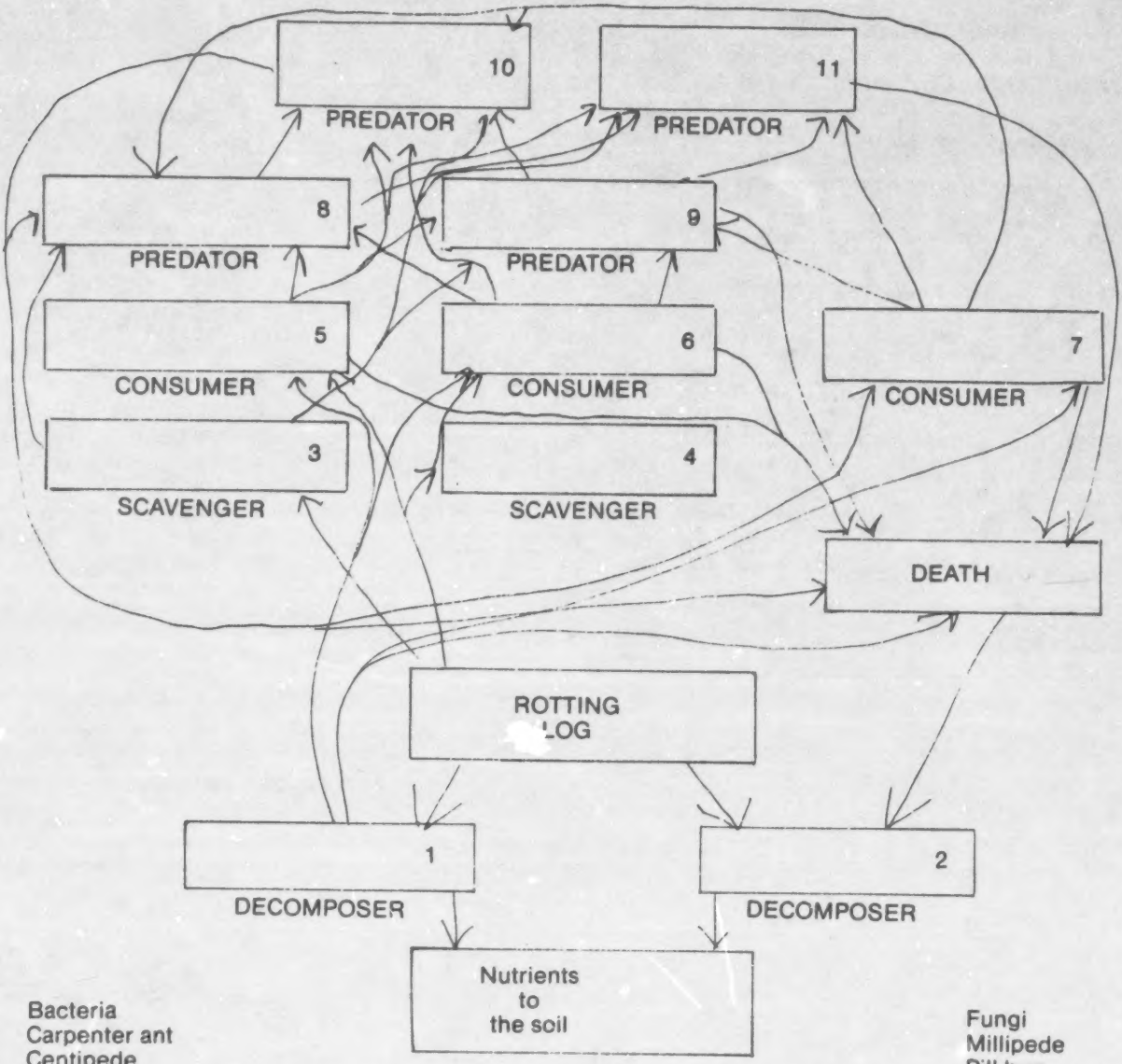
Data Page 2 **Food Web of Rotting Log Community**

Name _____

Date _____

Module _____

Complete the food web using the choices below:



Bacteria
Carpenter ant
Centipede
Click beetle

Spider

Termite

Woodpecker

Fungi
Millipede
Pill bug
Salamander

_____

Instructor's Signature

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Data Page 3—"Is There a Skunk in the Woodpile?"

Name _____

Date _____

Module _____

From the Food Web on Data Page 2, construct 2 food chains. Include in one food chain:

1 producer

1 scavenger

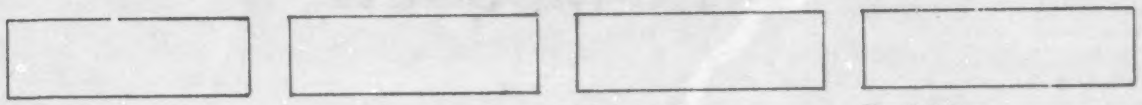
2 predators

Include in the other food chain:

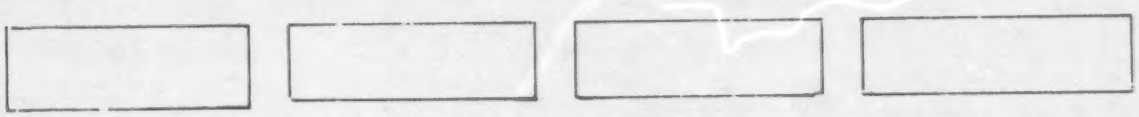
1 producer

1 consumer

2 predators



Producer Scavenger Predator Predator



Producer Consumer Predator Predator

_____

Instructor's Signature

THE
MEADOW

TERRESTRIAL COMMUNITIES – "MEDITATING IN A MEADOW"
(A Meadow Quadrant Study)

Background:

One obvious difference between a meadow and a woods is the lack of large trees in the meadow area. Other populations that inhabit the meadow are different also.

In this investigation you will work in teams to study the populations of a meadow community.

Instructional Objectives:

Each student will:

1. Help measure a meadow quadrant 3 meters x 3 meters.
2. Take part in a population count of a meadow quadrant.
3. Determine the dominant population of his given quadrant.
4. Compare population counts with other quadrant teams to predict dominant populations of the entire meadow area.

Materials:

1. Zim and Martin's *Flowers*—Golden Nature Study Guide
2. Zim and Cottam's *Insects*—Golden Nature Study Guide
3. Peterson's *A Field Guide to the Birds*
4. Zim and Hoffmeister's *Mammals*
5. insect nets
6. jars
7. string (about 13 meters long)
8. 1 metric tape measure
9. tree finders
10. 4 stakes
11. compass
12. insect keys
13. data sheets for meadow quadrant study

Procedure:

1. With members of your team, measure off a quadrant in the meadow 3 meters x 3 meters. To set up your quadrant, follow the same procedure that you used to set up a woodland quadrant in (1-9) in "Leafing Through a Woods".
2. When your quadrant is set up, use the diagram on your meadow data sheet to sketch in obvious features such as brush pile, rock, grass, etc.
3. Each team member should make observations from a different section of your quadrant.
4. Mark an "X" on the part of the diagram on your data sheet that corresponds to your observation unit.
5. On your data sheet record the number and kind of organisms you see within the area, any activities you observe, and how the organisms affect other living things. For an organism like grass, don't count each blade—just record the approximate area it covers.
6. Use an insect net to sweep the area. You can put any specimens you catch into a jar temporarily to identify them. When you are finished studying your specimens, release them.
7. Use resource books to help you identify weeds, flowers, birds, and insects you can't name.
8. Here is a sample chart like the one you will complete on your data sheet.

ORGANISM	LOCATION	NUMBER SEEN	ACTIVITIES	OTHER NOTES
grass	1,2,3,4,5	covers areas	none	hiding place and food for insects
bee	1,2,5,6,9	6	gathering nectar	pollinates flowers
goldenrod	7,8,9	20 stalks	none	provides nectar for bees

9. When your chart is complete, have your instructor check it. Answer the questions on the data sheet. When it is complete, have your instructor check it.

Data Sheet—"Meditating in a Meadow"

2. Even if the student has trouble being trustworthy (and they will), it won't change the commitment.

Name _____

3. Dependency is part of learning to trust.

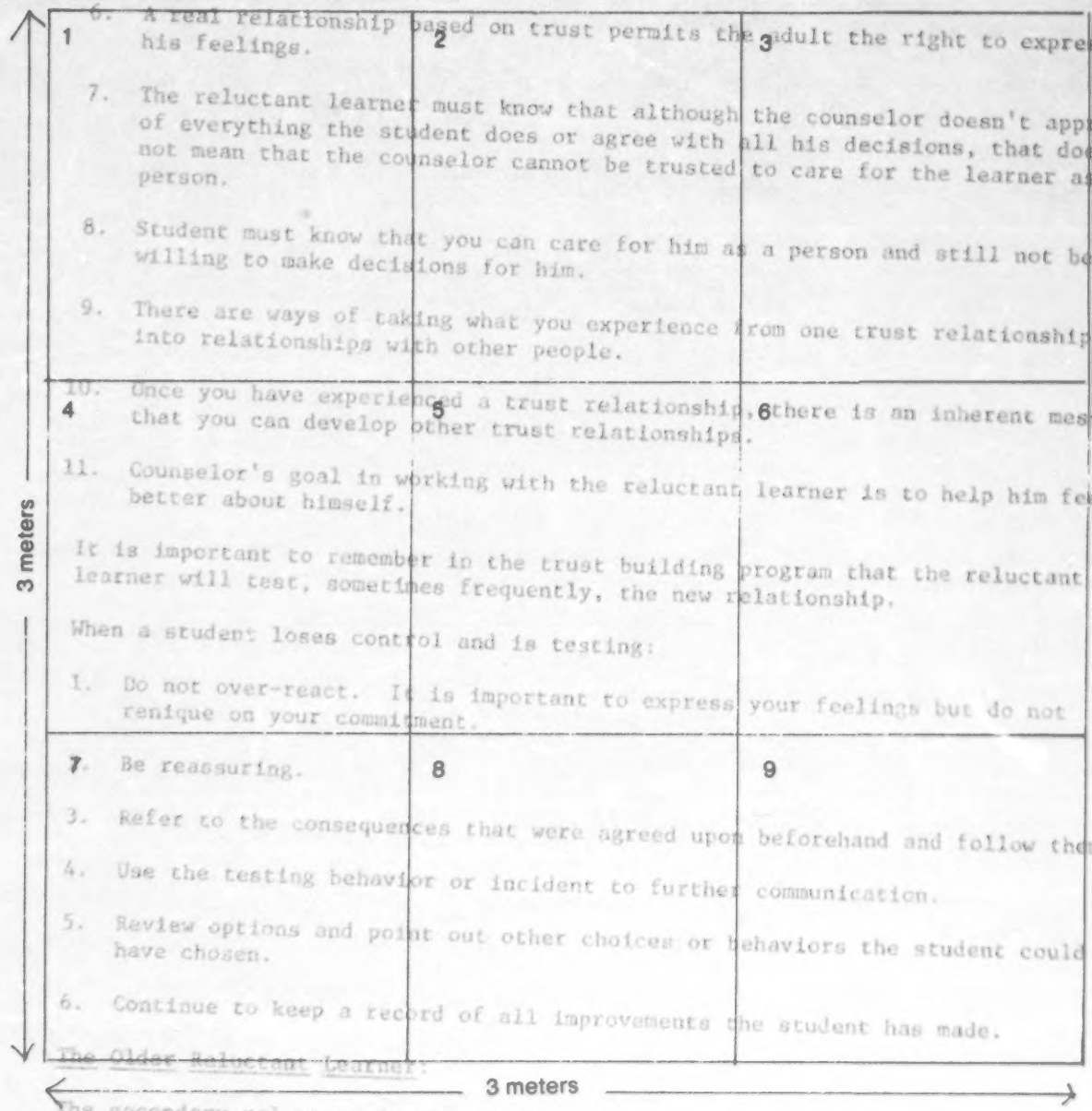
Date _____

4. There are no time lines for building a trust relationship.

Module _____

5. No matter how the student will test the adult -- anger, non-commital, withdrawing or lying -- the counselor or teacher will stand behind the promise of confidentiality.

#2 QUADRANT MAP—(Procedure #2)



6. A real relationship based on trust permits the adult the right to express his feelings.

7. The reluctant learner must know that although the counselor doesn't approve of everything the student does or agree with all his decisions, that does not mean that the counselor cannot be trusted to care for the learner as a person.

8. Student must know that you can care for him as a person and still not be willing to make decisions for him.

9. There are ways of taking what you experience from one trust relationship into relationships with other people.

10. Once you have experienced a trust relationship, there is an inherent message that you can develop other trust relationships.

11. Counselor's goal in working with the reluctant learner is to help him feel better about himself.

It is important to remember in the trust building program that the reluctant learner will test, sometimes frequently, the new relationship.

When a student loses control and is testing:

1. Do not over-react. It is important to express your feelings but do not renique on your commitment.

7. Be reassuring.

3. Refer to the consequences that were agreed upon beforehand and follow them.

4. Use the testing behavior or incident to further communication.

5. Review options and point out other choices or behaviors the student could have chosen.

6. Continue to keep a record of all improvements the student has made.

The Older Reluctant Learner:

The secondary reluctant learner feels that school is a bust because nobody really cares; school is boring. I'm too grown-up for all that kid stuff. I've never made it before, what makes you think

Instructor's Signature

Data Sheet – Population Count –
Procedure #5 – Meditating in a Meadow"
(Continued)

Name _____

Date _____

Module _____

ORGANISM (POPULATION)	LOCATION	NUMBER	ACTIVITIES	OTHER NOTES

_____

Instructor's Signature

Data Sheet – Population Count – Procedure #5 – Meditating in a Meadow" (Continued)

Name _____

Date _____

Module _____

Questions to Answer:

1. Which organisms did you see in the greatest numbers in your quadrant? _____

_____

_____

How many did you see of each? _____

2. What were the dominant organisms in your quadrant? _____

_____

_____

3. Give two examples from your observations that show how a dominant population affects other populations in the meadow community. _____

_____

_____

4. Post the results from your population counts along with results from other teams. _____

_____

_____

5. Compare the results from your quadrant with those from other quadrant teams. What populations were dominant in their quadrants? _____

_____

_____

6. What are the dominant populations of the entire meadow community? _____

_____

_____

_____

Instructor's Signature

"ONE THING LEADS TO ANOTHER"

Background:

Communities undergo a constant change. You have noted dominant populations in a meadow quadrant and in a woodland quadrant, but if you were to visit these same areas 20 years from now, you might find very different dominant populations. The process of gradual change in a community is known as *SUCCESSION*. During succession, plant populations are constantly being replaced by other plants. Since animals depend on plants for food, the change in types of plants in an area also brings about a change in types of animals.

In a meadow the soil becomes saturated with water in spring and early summer. Only plants that will tolerate waterlogged soil will grow. These plants occupy more and more area and begin to produce shade, take in water which is lost through transpiration (evaporation of water from plants), and produce more soil as they die and decay. The drier, shaded soil is more suitable to shrubs and the grasses gradually disappear. The woods area begins as humum accumulates. The soil becomes filled with bacteria and fungi and other trees begin to invade. The plants which cannot tolerate shade will disappear and shade tolerant trees will dominate the area.

Instructional Objectives:

In this investigation you will be observing four areas to see the gradual succession from a meadow to a woods.

1. Each student will observe four areas representing the stages of succession from a meadow to a woodland community.
2. Each student will record the type, structure, and pH of the soil in each area observed.
3. Each student will name the dominant types of plants for each area observed.
4. Each student will compute or estimate the average height of plants in each area.
5. Each student will name at least 4 animals found in each area.
6. Each student, by numbering pictures from (1-4), will correctly show stages of succession from a meadow to a woods.

Materials:

1. meter stick
2. soil testing kit (pH paper, bow and distilled water)
3. map of O.E.C.
4. pH color chart
5. data sheets for "One Thing Leads To Another"

Procedure:

You will observe 4 different areas (refer to map of OEC):

1. grassy meadow
2. shrub area
3. small tree area
4. large tree area

For each area above, complete steps (1-7) below. Then fill in your data table and answer the questions on your data sheet.

1. Test soil for pH (acidity) by following these steps:
   a. Scoop up a bowl of soil (if the soil is too hard you will have to chip some off and put it in the bowl).
   b. Add a little distilled water and mix.
   c. Test the mixture with a strip of pH paper and record the color and pH on the data table provided on your data sheet. (To determine pH, match color of tested paper with colors on pH chart.)
2. On your data sheet record the type of soil (sandy, loamy, clay).
3. Is the soil loose or tightly packed? Record answer on data sheet.
4. What general type of plants do you see here?
5. Measure the height of several plants typical to this area. What is the approximate average height? (If plants are too tall to measure, you will have to estimate their height.)
6. What types of birds can you see in this area? (Name at least two.)
7. What other animals or evidence of animal life do you see? (Name at least two.)

Data Table—"One Thing Leads To Another"

Name _____

Date _____

Module _____

	Area 1 Meadow	Area 2 Shrub	Area 3 Small Tree	Area 4 Big Tree—Woods
1. a. color of tested pH paper				
b. pH of soil				
2. soil type				
3. soil texture				
4. plant types (weeds, flowers, bushes, trees, etc.)				
5. average ht. of plants				
6. types of birds				
7. other animals				

_____

Instructor's Signature

Data Sheet – "One Thing Leads To Another" –(Continued)

Name _____

Date _____

Module _____

Questions to answer:

1. How do the soils of meadow and woodland areas differ? _____

_____

_____

2. How do plants of a woodland area differ from those in the meadow? _____

_____

_____

_____

3. Why do the plants of a woodland area and meadow area differ? _____

_____

_____

_____

4. Why do the animals of a woodland area and meadow area differ? _____

_____

_____

_____

_____

Instructor's Signature

Data Sheet — "One Thing Leads To Another" (Continued)

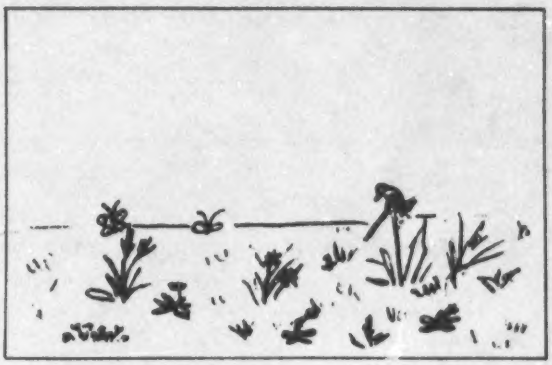
Name _____

Date _____

Module _____

Questions to answer: (Continued)

5. Look at the four pictures below. They represent the four areas you have observed. Number the pictures from (1-4) to show the correct order for stages of succession from a meadow to a woods.



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Instructor's Signature

Rocky River City School District
Outdoor Education Center

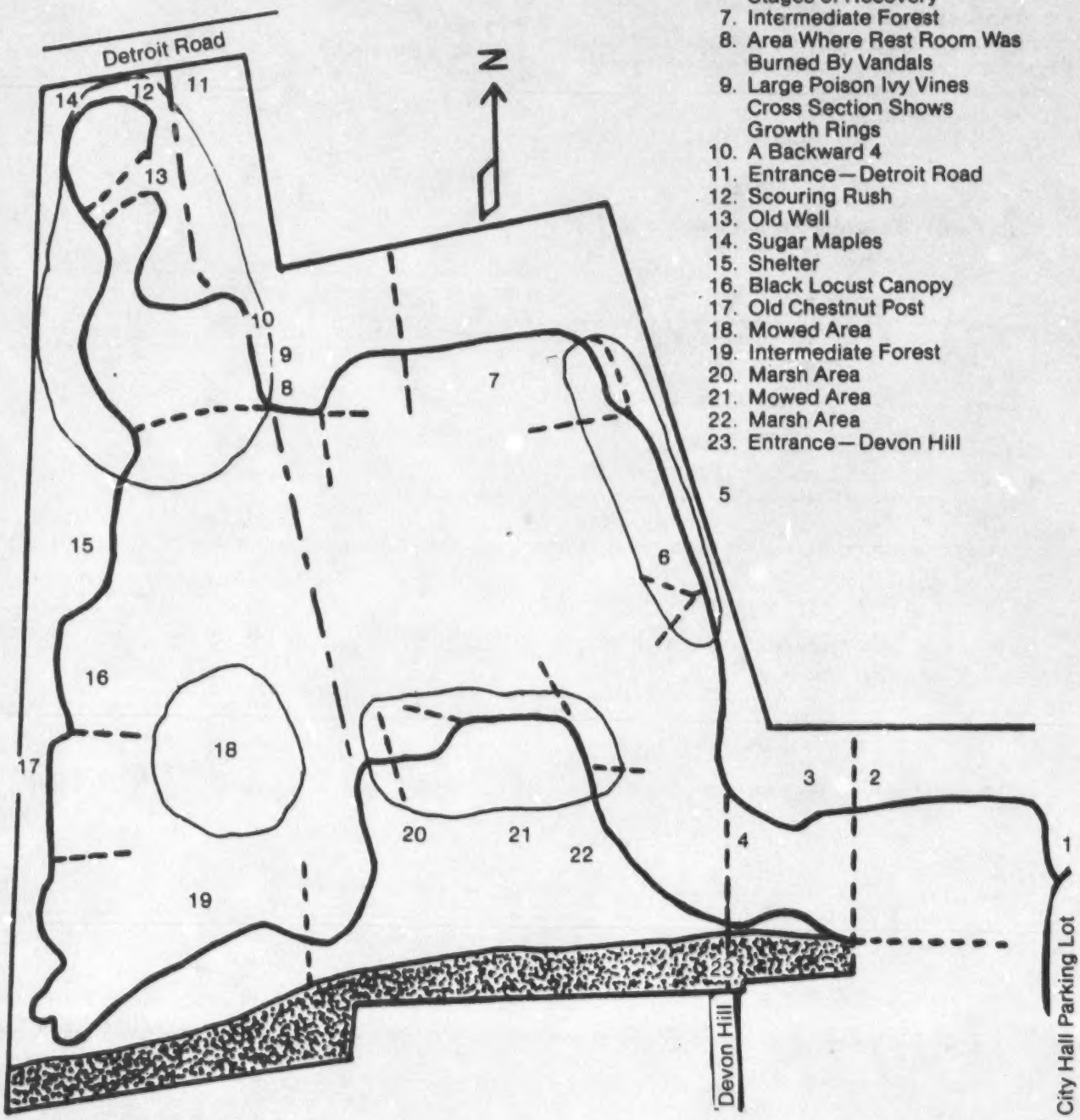
Hiking Trail Map

Hiking Trail — Crossing Trails

Sewer Easement — Road

Areas Of Interest

1. Entrance—City Hall
2. Mixed Forest
3. Grape Vine Canopy
4. Intermediate Forest
5. Condominium Construction
6. Cultivated Area In Early Stages of Recovery
7. Intermediate Forest
8. Area Where Rest Room Was Burned By Vandals
9. Large Poison Ivy Vines Cross Section Shows Growth Rings
10. A Backward 4
11. Entrance—Detroit Road
12. Scouring Rush
13. Old Well
14. Sugar Maples
15. Shelter
16. Black Locust Canopy
17. Old Chestnut Post
18. Mowed Area
19. Intermediate Forest
20. Marsh Area
21. Mowed Area
22. Marsh Area
23. Entrance—Devon Hill



"LET'S MEDDLE IN A MEADOW"

Background:

Like the woodland, the meadow is composed of biotic, (living) and abiotic, (non-living) factors, all of which interact. Even to the most casual observer the meadow appears to be quite different from the woodland. The major difference will be in the plant life and this should affect the animal life of the community. The lack of trees should also affect the physical factors of the community.

Instructional Objectives:

At the end of this activity you should be able to make the following physical measurement using the instrument provided.

a. relative humidity
b. temperature
c. wind direction
d. wind speed

Materials:

1. Sling psychrometer
2. Thermometer
3. Anemometer
4. Wind vane
5. Data page

Procedure:

1. Follow the procedure as outlined under "Physical Factors of a Woodland Community."
2. Complete the data page.

Name _____

Date _____

Module _____

Data Page—"Let's Meddle in A Meadow"

Date	Temp.	Relative Humidity	Wind Direction	Wind Speed	Sky Conditions

1. Was relative humidity related to temperature? _____

2. Was relative humidity related to sky conditions? _____

3. Was relative humidity related to wind speed? _____

4. Was relative humidity related to wind direction? _____

_____
Instructor's Signature

101

"KEEPING A DATE WITH DATA"

A Comparison Between the Physical Factors of a Meadow and Woodland Community.

Background:

Due to the nature of plant life (mostly large trees), one would expect to observe a difference in temperature, wind speed and relative humidity between the meadow and woodland on any specific day. The purpose of this activity is to have you analyze collected data and make these comparisons.

Instructional Objectives:

At the end of this activity you should be able to correctly analyze collected data and make a valid comparison of the physical factors of a meadow and woodland community.

Materials:

1. Data pages from:
   a. "Weather in the Woods"
   b. "Let's Meddle in a Meadow"
2. Data page "Keeping a Date with Data"

Procedure:

1. Using your data pages from "Weather in the Woods" and "Let's Meddle in a Meadow", complete the data page for this activity.
   NOTE: The dates of your observations of a woods and meadow must be the same.
2. Answer the questions pertaining to your observations.

Data Page: "Keeping a Date With Data"

Name _____

Date _____

Module _____

Date _____

	WOODLAND	MEADOW
Temperature		
Relative Humidity		
Wind Direction		
Wind Direction		
Sky Conditions		

Date _____

	WOODLAND	MEADOW
Temperature		
Relative Humidity		
Wind Direction		
Wind Speed		
Sky Conditions		

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Data Page: "Keeping A Date With Data" (Continued)

Name _____

Date _____

Module _____

QUESTIONS:

1. Is there a consistent difference each day between the temperature of a wooded area and the meadow area? _____ What is the difference? _____

2. Is there a consistent difference in humidity? _____

What is the difference? _____

3. Explain why there were differences (if any) in relative humidity and temperature between a wooded area and a meadow area. _____

_____

Instructor's Signature

103

"WHAT'S BUGGING YOU?"

Background:

Insects belong to the phylum of animals known as arthropods. Arthropods have jointed legs, an exoskeleton, and a segmented body. Arthropods include insects, chiggers, spiders, scorpions, mites, ticks, daddy longlegs, centipedes, millipedes, crayfish, crabs, shrimp, and sowbugs. Insects differ from other arthropods in that they have: (1) 3 pairs of legs, (2) 1 pair of antennae and (3) 3 body parts.

There are more different kinds of insects in the world than all other living things put together. Eighty per cent of all animals are arthropods and about three-fourths of all arthropods are insects. There are very few food chains that do not contain insects. Insects are so numerous and widespread you can study them almost anywhere.

The class of insects is further broken down into smaller groups called orders. All the insects from a particular order have certain characteristics that are alike. For instance, all Diptera (houseflies, horseflies, deerflies, mosquitos, midges, etc.) have one pair of wings and one pair of structures called Halteres. Halteres look like golf tees and are found under the wings of Diptera.

In this activity you will collect insects and use the "Key to the Order of Insects" to identify the order to which each insect belongs. To key your insects correctly you will have to make some close observations. For some insects you may find a hand lens will help you see them more distinctly.

Instructional Objectives:

1. Each team of students, using a collecting net and killing jar, will collect at least 5 different kinds of insects representing at least three orders.
2. Each student, using pins and a spreading board, will correctly pin at least one insect.
3. Each student, using an insect key and hand lens, will correctly identify 5 different insects.

Materials:

1. insect net
2. killing jars
3. cotton
4. carbon tetrachloride or other killing agent
5. dissecting scopes
6. hand lens
7. insect key
8. data sheet
9. insect pins
10. spreading boards
11. white 3 x 5 cards
12. scissors
13. glue

Procedure:

A. *Collecting*

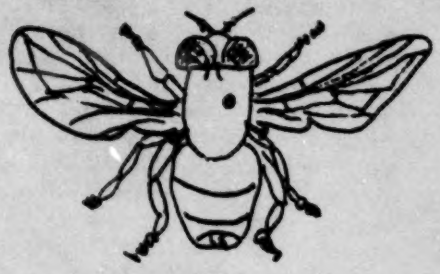
1. Each team will need at least 1 insect net and 1 killing jar. Use the net to catch large individual specimens such as grasshoppers and butterflies. Sweep the net through weeds and tall grass to catch smaller insects you otherwise might not see.
2. To keep your insects from flying out of the net, whip the net so insects go to the bottom of the net and flip the net to make it rest across the hooped opening.

   When you have some specimens, grasp one hand around the net just above your captured insects. Place the end of your net that holds your captured insects into your killing jar. Place the lid over the mouth of the killing jar and hold it there as tightly as possible for about a minute. Remove the end of the net from the killing jar and put the stunned insects back into the killing jar. This method of collecting is particularly useful when handling stinging insects.
3. If you catch a butterfly or moth, special care must be taken to prevent battered and torn wings. Once you have the butterfly or moth cornered in the bottom of the net, gently but firmly squeeze the thorax between the thumb and forefinger. This will stun the insect and prevent it from beating the scales off its wings when it is dropped into the killing jar.
4. You will find insects in many places. Don't overlook those that might hide in flowers or under leaves or logs or those that blend in with the bark of a tree or look like a leaf on a twig. You will find it easier to catch some of these insects just using a lid to brush them into your killing jar.
5. *At all times be careful not to inhale fumes from your killing bottle.*

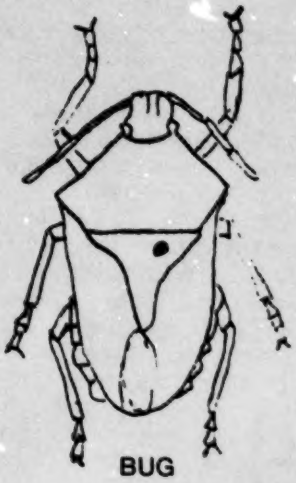
B. *Pinning*

6. Once you have caught and killed your insects, you will need to pin them to make them easier to handle and study.

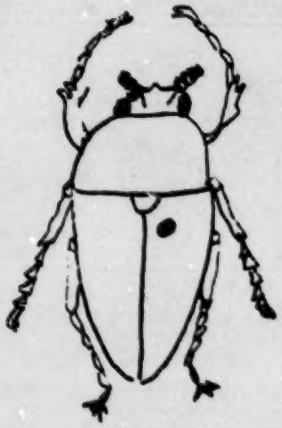
7. Empty the specimens from your killing jar onto a spreading board. If any insect is still moving, put him back into the killing jar until he is dead.
8. Follow these directions to pin your collected insects: For most insects, the pin should be inserted through the thorax from dorsal (top) to ventral (bottom), slightly to the right of the middle. Slide the pin through until your insect is about 6 mm from the top of the pin. The correct placement of pins is shown on pictures below:



FLY

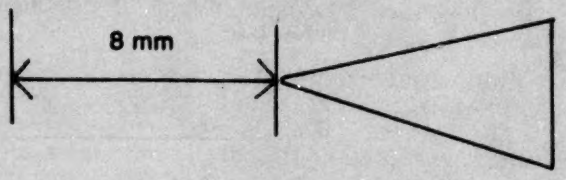


BUG



BEETLE

9. (optional)
   Some insects are too small to be pinned in the way described in #8. They must be glued onto a point. To make points you will need a 3 x 5 card, scissors, and glue.
10. From your card, cut points about 8 mm long in the shape shown.



11. Stick a pin through the base of each point. Push the point up to about 6 mm from the top of the pin.
12. Put a small drop of glue on the tip of the point and press the right side of your insect to the glued tip. It takes practice to get them straight! Your finished product should look something like this:

side top

13. When you have pinned or pointed at least one insect, have your instructor sign part B of your data sheet.

C. *Identification*

14. Use your insect key to key out at least 5 different insects. A hand lens or dissecting scope may be needed to observe some of the features mentioned in the key. Hold on to just the top of the pin as you look at your specimens so you won't damage their legs or antennae.
15. Complete part C of your data sheet and have your instructor check to see if you have done your keying correctly. When you have correctly keyed 5 different insects your instructor will sign part C of your data sheet.

105

Data Sheet: — "What's Bugging You?"

Name _____

Date _____

Module _____

A. Check the box below when your team has at least 5 different insects in your killing jar.

☐

B. When you have pinned or pointed at least 1 insect have your instructor sign this box.

☐

C. Insects I have identified:

	Common name	Order name
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

When you have correctly identified at least 5 insects, have your instructor sign your data sheet.

_____

Instructor's Signature

Key To Order Of More Common Adult Insects

1a. Without wings, all of the abdominal segments usually visible in a top view of the insect 2

b. With wings (some insects are not obviously winged because the flying wings are covered with hard structures. In some the hard covering is short and exposes much of the abdomen) 16

2a. Without legs, eyes or antennae; living under a waxy or cottony covering and occuring in colonies firmly attached to tree twigs, fruit or leaves ..... (scale insects) HOMOPTERA

b. Legs and antennae and most usually the eyes present 3

3a. Abdomen ending in three long, thread-like tails; antennae long ..... (silverfish and bristletails) THYSANURA

b. Abdomen without long tails; antennae may be short or long 4

4a. Antennae shorter than the head, not easily seen; body flattened from side to side or from top to bottom; parasites on animals 5

b. Antennae longer than the head, easily seen, not usually parasites 8

5a. Body flattened from side to side; legs long and able to jump; with sucking mouth parts ..... (fleas) SIPHONAPTERA

b. Body flattened from top to bottom; legs short and not able to hop 6

6a. Abdomen sac-like and without distinct segments, eyes clearly visible; tarsi 5-segmented; about housefly size; sheep parasites ..... (sheep keds) DIPTERA

b. Abdominal segments distinct; eyes small or absent; tarsi 1- to 2-segmented; less than ⅛ inch long 7

7a. Head narrowed toward the front, the entire head narrower than the thorax; mammal parasites ..... (true lice, sucking lice) ANOPLURA

b. Head broadly rounded in front, the entire head wider than the thorax; mostly bird parasites ..... (bird lice, chewing lice) MALLOPHAGA

8a. Body strongly constricted between the thorax and abdomen ..... (ants) HYMENOPTERA

b. Thorax and abdomen broadly joined 9

9a. Body scaly; a coiled tongue sometimes visible; usually found on tree trunks ..... (wingless butterfly) LEPIDOPTERA

b. Body not scaly 10

10a. With a sucking beak, the beak of some may seem to come from between the front legs 11

b. Beak absent, chewing mouth parts 12

11a. With 2 tube-like projections near the end of the abdomen; soft-bodied and living in colonies on plants; antennae long; beak coming from near the front legs ..... (aphids) HOMOPTERA

b. Without tube-like projections on abdomen; beak arises from front of head ..... (true bug) HEMIPTERA

12a. Tarsi either 5-segmented or the hind legs adapted for jumping ..... (walking stick) ORTHOPTERA

b. Tarsi with less than 5 segments and the hind legs not adapted for jumping 13

13a. Ant-like appearance except they are soft-bodied and cream-colored, with 4-segmented tarsi, eyeless, and antennae look like a string of round beads; the thorax and abdomen are broadly joined ..... (termite) ISOPTERA

b. Not fitting the description of 13a; eyes usually well developed 14

14a. With a forked tail used for jumping near the end of the body; the spring tail may be folded under the body ..... (springtails) COLLEMBOLA

b. Without a forked tail 15

15a. Oval-shaped and louse-like in appearance; antennae long and thread-like ..... (psocids, book lice, bark lice) CORRODENTIA

b. Body narrow; found on flowers and leaves ..... (thrips) THYSANOPTERA

16a. With only one pair of wings; the hind pair reduced to small structures that look like golf tees ..... (flies, mosquitos, gnats, midges) DIPTERA

b. With two pairs of wings, although the first pair may be thick and hard and not function as organs of flight 17

17a. Front wings thicker in texture than the hind wings for all or part of their area 18

b. Front and hind wings both of the same texture throughout 21

18a. Front wings horny or leathery in texture throughout and meeting in a straight line down the center of the back usually 19

b. Front wings parchment-like or leathery throughout or on the basal half only; they do not meet in a straight line down the center of the back. In the lace-bugs the entire top of the insect looks like lace 20

19a. Front wings short leaving much of the abdomen exposed; a pair of pincher-like appendages at the end of the abdomen ..... (earwigs) DERMAPTERA

b. Front wings usually cover all the abdomen; never with abdominal appendages ..... (beetles) COLEOPTERA

20a. With a jointed beak; basal part of the front wing thickened and the tip membranous. Antennae with 5 or less segments ..... (true bugs) HEMIPTERA

b. With chewing mouthparts; front wings parchment like throughout; antennae with many segments ..... (grasshoppers, katydids, locusts, cockroaches, mantids, praying mantis, crickets) ORTHOPTERA

21a. Wings with scales on all or part of their area; mouthparts in the form of a coiled tongue ..... (butterflies, moths, skippers) LEPIDOPTERA

b. Wings without scales although they may have hairs 22

22a. Wings long, narrow, veinless, all four of equal size, and fringes with long hairs, small insects about $\frac{1}{10}$ inch long; tarsi 1 or 2 segmented ..... (thrips) THYSANOPTERA

b. Not fitting the description in 21a 23

23a. Mouthparts composed of a beak arising near the back of the head near the front legs; wings held roof-like over the body, the hind pair smaller than the front pair ..... (aphids, cicadas, leafhoppers, treehoppers) HOMOPTERA

b. Mouthparts not in the form of a piercing beak although the front of the head may be prolonged into a snout; wings not held roof-like over the body; usually the hind pair of wings about the same size as the front pair or the abdomen with 2 or 2 long thread-like tails 24

24a. With many cross-veins (more than 15) in each wing 25

b. With few cross-veins or the veins indistinct 29

25a. Antennae about as long as the head and thorax together or longer 27

b. Antennae short and bristle-like, about as long as the head alone or shorter 26

26a. Hindwing much smaller than the front wing, abdomen ending in 2 or 3 long thread-like tails ..... (mayflies) EPHEMEROPTERA

b. Front and hind wing nearly equal; no abdominal tails; wings with a stigma and nodus ..... (dragonflies and damselflies) ODONATA

27a. Abdomen ending with 2 short tails . . . . . (stoneflies) PLECOPTERA

b. Abdomen without tails 28

28a. Head prolonged into a snout, the tip of the abdomen sometimes with a tail like a scorpion's . . . . . (scorpionflies) MECOPTERA

b. Head not prolonged into a snout . . . . . (lacewings, alderflies, ant lions, dobsonflies, snakeflies) NEUROPTERA

29a. All four wings long, narrow, equal sized, without distinct veins; wings about twice the body length . . . . . (termites) ISOPTERA

b. Insects not fitting the description in 28a 30

30a. Wings hairy; antennae thread-like and usually as long as or longer than the body; mouthparts indistinct; front and hind wings nearly equal in size . . . . . (caddisflies) TRICHOPTERA

b. Wings not hairy; chewing mouthparts present; hind wings noticeably smaller than the front wings 31

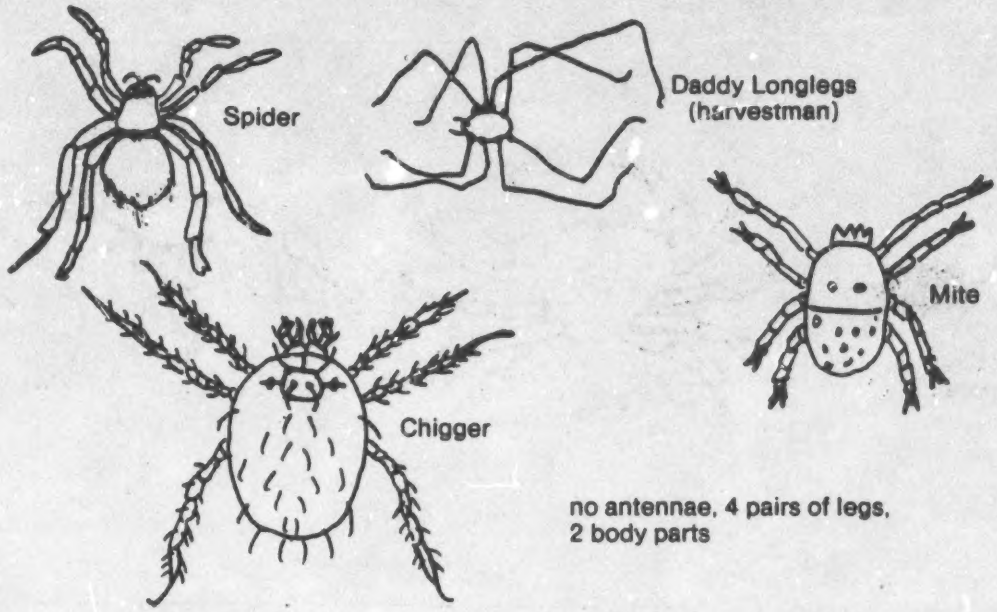
31a. Tarsi 2 or 3 segmented, small insects less than ⅛ inch long. Never constricted between the thorax and abdomen . . . . . (psocids, book lice, bark lice) CORRODENTIA

b. Tarsi 4 or 5 segmented; size variable; most are constricted between the thorax and abdomen . . . . . (bees, ants, wasps, sawflies) HYMENOPTERA

Source: Scheibner, R. A., "Key to the Order of Insects for 4-H Entomology Projects"

ARTHROPODS

Class *ARACHNIDA*



no antennae, 4 pairs of legs,
2 body parts

Class *CHILOPODA* (Centipedes)

flattened body, many segments, 1 pair of antennae, 1 pair of legs for each body segment, soil dweller

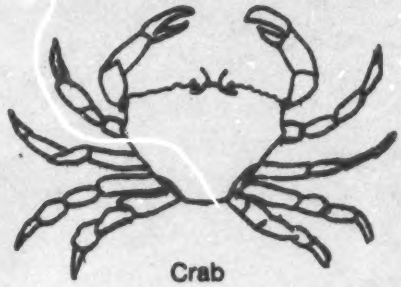
Class *DIPLOPODA* (Millipedes)

generally roundish body, many segments, 1 pair of antennae, 2 pairs of legs for each body segment, when disturbed they coil in a characteristic manner, found under logs and rocks.

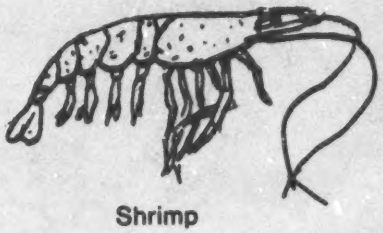
ARTHROPODS

Class *CRUSTACEA*

Sowbug
(potato bug)

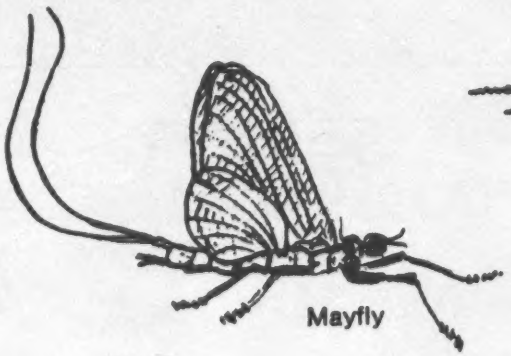


Crab



Shrimp

Class *INSECTA*

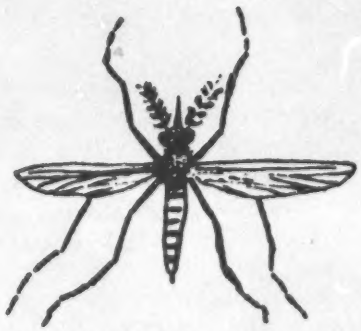


Mayfly

Caddisfly

Beetle

Grasshopper



Mosquito

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"WE DON'T CARE IF THE LIFE IS SOILED"

Background:

To most observers the only life we see lies above ground. The soil, however, has many organisms living within it. This activity is to make you aware of the kinds of life existing in the earth of a meadow.

Instructional Objectives:

At the end of this unit you should be able to:

1. Excavate a cube of soil 30 cm x 30 cm x 30 cm.
2. Identify the life present in this amount of soil.
3. Predict the amount of life in an area 100 X this amount.

Materials:

1. string
2. hand lens
3. metric tape measure
4. forceps
5. shovel
6. white bottomed pan
7. animal keys
8. data pages

Procedure:

1. Go to a meadow community.
2. Measure a square 30 cm x 30 cm on the ground.
3. Use a shovel to dig a section of earth within your square 30 cm deep. This will give you a volume of soil equal to 27,000 cc's.
4. Place the soil in a white bottomed pan and carefully sort out the bits of organic materials (dead or alive) that you find.
5. Fill in the data page.

Name_____

Date_____

Module_____

Data Page—"We Don't Care If The Life Is Soiled"

Include names of each organism if possible and numbers.

	Name	Number Found
I Plant Life		
II Animal Life A. Insects		
B. Other Arthropods		
C. Other Invertebrates		

_____

Instructor's Signature

Data Page – "We Don't Care If The Life Is Soiled" – (Continued)

Name _____

Date _____

Module _____

D. Evidence of Vertebrate life?

Name	Number Found

Based on your findings, how many earthworms would you expect to find in an area 10 times as large?

How many insects would you expect to find in an area 100 times as large?

_____

Instructor's Signature

"IS THERE A GENERATION GAP?"

Background:

In various parts of the Outdoor Education Center, mosses can be found. The moss is a relatively simple plant and is usually found where the soil is not very good. The moss really consists of two generations living together. One generation is called the gametophyte, which means gamete-producing plant, and the other generation is the sporophyte, which means spore-producing plant. The gametophyte generation is the part that we usually see. It is green, lies close to the ground and appears to be made up of "leaves". The "leaves" are not true leaves, for they have no stomata. The sporophyte generation grows out of the gametophyte plant, is slender, usually brown, and ends in a club-shaped capsule or spore case.

The term "alternation of generations" is used to describe the life cycle of the moss. The gametophyte generation produces gametes. One plant will produce eggs, another will produce sperms. In the presence of moisture the sperm will swim and fertilize the egg. The resulting zygote grows into a sporophyte generation that produces spores. When the spore germinates it grows into a gametophyte plant, either male or female, and thus the cycle is complete.

Instructional Objectives:

At the end of this activity each student should be able to:

1. recognize a moss in the field.
2. correctly identify the gametophyte generation.
3. correctly identify the sporophyte generation.
4. expel spores from the sporophyte of a moss and use a microscope to observe them.
5. correctly identify the gametophyte generation and sporophyte generation in the drawing of the moss.

Materials:

1. Moss collected from the field
2. compound microscope
3. monocular microscope
4. dissecting needle
5. Text: *Life, Its Forms and Changes*
6. data page

Procedure:

1. Go to the field and collect several moss plants. Find some with sporophyte generations.
2. Examine the plant with a compound microscope.
3. Notice the structure of the "leaves" and the structure of the sporophyte.
4. With a monocular microscope examine one of the "leaves". Do you see any stomata?
5. Find a moss sporophyte. Break off the capsule and place it in a drop of water on a slide. Crush the capsule with a dissecting needle and observe the spores, which are small, spherical structures.
6. Gently pull a plant out of the underlying soil. Examine the fuzzy growth at the lower end of the plant. These are the Phyzoids.
7. Complete the drawings and answer the related questions.

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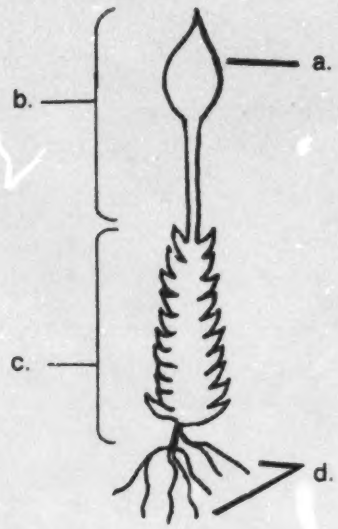
Data Page—"Is There A Generation Gap?"

Name _____

Date _____

Module _____

Study the drawing of the moss. Identify the structure as: sporophyte, gametophyte, spore case, rhizoids. Place your answers on the line provided.



a. _____

b. _____

c. _____

d. _____

1. Why are the "leaves" of the moss not true leaves? _____

_____

2. What is the function of the rhizoids? _____

_____

3. By what two methods do mosses reproduce?

   1. _____

   2. _____

4. What reproductive structures are produced by the:

   1. gametophyte generation? _____

   2. sporophyte generation? _____

_____

Instructor's Signature

"LET'S KEEP OUR RELATIONSHIPS SYMBIOTIC"

Background:

For the purpose of this activity let's define *symbiosis* as the close relationship between two living organisms of different species. Now, let us divide symbiosis into two other groups: Mutualism and commensalism.

Mutualism is a special kind of symbiotic relationship in which both species benefit and neither can exist without the other.

Commensalism is a special kind of symbiotic relationship in which one of the individuals benefits but the other individual is neither benefited nor harmed.

There are subtle gradations between the various symbiotic relationships. It is sometimes difficult to distinguish between commensalism and mutualism.

Instructional Objectives:

At the end of this unit you should be able to:

1. correctly define:
   a. symbiosis
   b. mutualism
   c. commensalism
2. give a list of 4 symbiotic organisms correctly identify their relationship as either mutualism or commensalism.
3. satisfactorily defend your statement why you believe the lichen is an example of mutualism or commensalism.
4. explain why a fungus growing on a dead tree is not an example of symbiosis.

Materials:

1. Library resources—*Ecology and Field Biology*, Smith, Harper & Row, 1974 and others.
2. Data pages.

Procedure:

Go to the library and read about:

1. Lichens
2. Remora and shark
3. Nodule growth of nitrogen-fixing bacteria on the roots of legumes
4. Yucca moth and yucca plant
5. Orchids
6. Spanish moss
7. Barnacles and Horseshoe crabs

Questions For Discussion: "Let's Keep Our Relationship Symbiotic"

Name _____

Date _____

Module _____

1. What two different plants are found in a lichen?

   a. _____

   b. _____

2. What is the role of (a) above? _____

   _____

3. What is the role of (b) above? _____

   _____

4. Do you believe the lichen is an example of mutualism or commensalism?

   Defend your answer. _____

   _____

   _____

   _____

5. Briefly explain the relationship between the following organisms. State whether their relationship is mutualism or commensalism and defend your answer. _____

   a. Nitrogen-fixing bacteria and legumes _____

   _____

   _____

   _____

   _____

   b. Remora and shark _____

   _____

   _____

   _____

Continued

Name _____

Date _____

Module _____

c. Yucca moth and yucca plant _____

_____

_____

d. orchids _____

_____

_____

e. spanish moss _____

_____

_____

f. barnacles _____

_____

_____

g. Why is a fungus growing on a dead tree not a symbiotic relationship?

_____

_____

_____

6. Obtain a specimen of a lichen. Can you see the two plants that make up the lichen?

_____

7. Obtain a specimen of a legume. Look at the nodules. Show the lichen and the legume to your instructor.

_____

Instructor's Signature

On Your Own: — "Let's Keep Our Relationships Symbiotic"

Name _____

Date _____

Module _____

1. Discuss parasitism. In your discussion define *parasitism* and identify a specific parasite and its host. Do you believe parasitism is an example of symbiosis? Why or why not?

_____

_____

_____

_____

_____

_____

_____

2. Define *amensalism.* Refer to *Ecology and Field Biology* by Smith, and design an experiment that is an example of amensalism.

_____

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Instructor's Signature

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